

inc levels may be lowered by diarrhea, kidney disease, cirrhosis of the liver, diabetes, or the consumption of fiber, which causes zinc to be excreted through the intestinal tract. A significant amount of zinc is lost through perspiration. The consumption of hard water

The consumption of hard water also can upset zinc levels. Compounds called phytates that are found in

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grains and legumes bind with zinc so that it cannot be absorbed.

If you take both zinc and iron supplements, take them at different times. If these two minerals are taken together they interfere with each other's activity.

Do not take a total of more than 40 milligrams of zinc daily. While daily doses less than 40 milligrams enhance the immune response, doses of more than 40 milligrams can depress the immune system.

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AIR POLLU

Air pollution is the discharge of pollutants into the atmosphere, which can cause health problems such as irritated throats, asthma, and other respiratory conditions. Exposure to pollutants found in polluted air can have damage to the respiratory system and the cardiovascular system. Dust particles from diesel engines can be especially harmful, as they can penetrate deep into the lungs. A number of deaths have been linked to air pollution, and the ability to maintain good health is often compromised. Older people are more likely to suffer from the effects of air pollution, and the duration of exposure can be a factor. Chemical pollutants, such as lead, can, at high levels, cause serious health problems. Air pollution is a major public health concern, and it is important to take steps to reduce its impact.

Air pollution

Some experts estimate that as many as 20 percent of elderly people who take diuretics may be deficient in sodium. In some cases of disorders such as fibromyalgia, studies have shown that moderate amounts of sodium may be needed as well (natural sea salt is recommended). Symptoms of sodium deficiency can include abdominal cramps, anorexia, confusion, dehydration, depression, dizziness, fatigue, flatulence, hallucinations, headache, heart palpitations, an impaired sense of taste, lethargy, low blood pressure, memory impairment, muscular weakness, nausea and vomiting, poor coordination, recurrent infections, seizures, and weight loss. Excessive sodium intake can result in edema, high blood pressure, potassium deficiency, and liver and kidney disease.

Sources

Virtually all foods contain some sodium, but those that are processed (i.e., in a package rather than being fresh) have more.

Comments

A proper balance of potassium and sodium is necessary for good health. Because most people consume too much sodium, they typically need more potassium as well. An imbalance between sodium and potassium can lead to heart disease. If you sweat excessively from exercise or heat, you will need to make sure to replace salt lost in perspiration through foods or beverages with added salt.

Sulfur

An acid-forming mineral that is part of the chemical structure of the amino acids methionine, cysteine, taurine, and glutathione, sulfur disinfects the blood, helps the body to resist bacteria, and protects the protoplasm of cells. It aids in necessary oxidation reactions in the body, stimulates bile secretion, and protects against toxic substances. Because of its ability to protect against the harmful effects of radiation and pollution, sulfur slows the aging process. Found in all body tissues, it is needed for the synthesis of collagen, a principal protein that gives the skin its structural integrity.

Sources

Brussels sprouts, dried beans, cabbage, eggs, fish, garlic, kale, meats, onions, soybeans, turnips, and wheat germ contain sulfur, as do the amino acids cysteine, cystine, and methionine. Sulfur is also available in tablet and powder forms. Methylsulfonylmethane (MSM) is a good form of sulfur.

Comments

Moisture and heat may destroy or change the action of sulfur in the body. Sulfur is one of the key substances that makes garlic the "king of herbs."

Vanadium

Vanadium is needed for cellular metabolism and for the formation of bones and teeth. It plays a role in growth and reproduction and inhibits cholesterol synthesis. Vanadium

has been shown to have the ability to improve insulin utilization, resulting in improved glucose tolerance. A vanadium deficiency may be linked to cardiovascular and kidney disease, impaired reproductive ability, and increased infant mortality. Vanadium is not easily absorbed. Athletes may require more of this trace mineral than nonathletes.

Sources

Vanadium is found in dill, fish, olives, meat, radishes, snap beans, vegetable oils, and whole grains.

Comments

There may be an interaction between vanadium and chromium. If you take supplemental chromium and vanadium, take them at different times. Tobacco use decreases the uptake of vanadium.

Zinc

This essential mineral is important in prostate gland function and the growth of the reproductive organs. Zinc may help prevent acne and regulate the activity of oil glands. It is required for protein synthesis and collagen formation and promotes a healthy immune system and the healing of wounds. Zinc also enhances acuity of taste and smell. It protects the liver from chemical damage and is vital for bone formation. It is a constituent of insulin and many vital enzymes, including the antioxidant enzyme superoxide dismutase (SOD). It also helps to fight and prevent the formation of free radicals in other ways. A form of zinc called zinc monomethionine (zinc bound with the amino acid methionine), sold under the trade name OptiZinc, has been found to have antioxidant activity comparable to that of vitamin C, vitamin E, and beta-carotene. Zinc lozenges have been reported to be effective in relieving symptoms of the common cold and reducing the duration of colds.

Sufficient intake and absorption of zinc are needed to maintain the proper concentration of vitamin E in the blood. In addition, zinc increases the absorption of vitamin A. For optimum health, a proper 1-to-10 balance between copper and zinc levels should be maintained.

A deficiency of zinc may result in the loss of the senses of taste and smell. It can also cause fingernails to become thin, peel, and develop white spots. Other possible signs of zinc deficiency include acne, delayed sexual maturation, fatigue, growth impairment, hair loss, high cholesterol levels, impaired night vision, impotence, increased susceptibility to infection, infertility, memory impairment, a propensity to diabetes, prostate trouble, recurrent colds and flu, skin lesions, and slow wound healing.

Sources

Zinc is found in the following food sources: beef, brewer's yeast, dairy products, dulse, egg yolks, fish, kelp, lamb, legumes, lima beans, liver, meats, mushrooms, oysters, pecans, poultry, pumpkin seeds, sardines, seafood, soy lecithin, soybeans, sunflower seeds, torula yeast, and whole grains. Herbs that contain zinc include alfalfa, burdock root, cay-

cardiovascular disease, male infertility, cataracts, AIDS, and high blood pressure. For very sick patients in the intensive care unit, selenium appears to reduce mortality rates. In one study, the death rate was 14 percent lower in those getting a high dose of selenium (1,000 micrograms a day). Selenium is incorporated into over twenty-five proteins, called selenoproteins, that play pivotal roles in a number of bodily activities, from activating thyroid hormones to regenerating vitamin C.

Selenium deficiency has been linked to cancer and heart disease. It has also been associated with exhaustion, growth impairment, high cholesterol levels, infections, liver impairment, pancreatic insufficiency, and sterility. There is some thought that selenium deficiency might be linked to a host of viral outbreaks, from new strains of influenza to Ebola, wrought by the rapidly mutating virus's interaction with selenium-deficient hosts in places like Africa and China where there is little or no selenium in the soil.

Some have found selenium to be related to cognitive function. One study found that lower selenium content in fingernails was related to poorer cognitive function in a group of elderly Chinese. This finding supports the hypothesis that a lifelong low selenium level is associated with lower cognition.

Sources

Selenium can be found in meat and grains, depending on the selenium content of the soil where the food is raised. Because New Zealand soils are low in selenium, cattle and sheep raised there have suffered a breakdown of muscle tissue, including the heart muscle. However, human intake of selenium there is adequate because of imported Australian wheat. The soil of much American farmland is low in selenium, resulting in selenium-deficient produce.

Selenium can be found in Brazil nuts (the only truly concentrated natural source), brewer's yeast, broccoli, brown rice, chicken, dairy products, dulse, eggs, garlic, kelp, liver, molasses, onions, salmon, seafood, torula yeast, tuna, vegetables, wheat germ, and whole grains. Herbs that contain selenium include alfalfa, burdock root, catnip, cayenne, chamomile, chickweed, fennel seed, fenugreek, garlic, ginseng, hawthorn berry, hops, lemongrass, milk thistle, nettle, oat straw, parsley, peppermint, raspberry leaf, rose hips, sarsaparilla, uva ursi, yarrow, and yellow dock.

Comments

The typical dietary intake of selenium is 80 to 150 micrograms. Taking up to 200 micrograms per day is considered safe for most people. This is half the maximum allowable dose.

Cautions

Symptoms of selenosis (excessively high selenium levels) can include arthritis, brittle nails, garlicky breath, gastrointestinal disorders, hair loss, irritability, liver and kidney impairment, a metallic taste in the mouth, pallor, skin eruptions, tooth loss, and yellowish skin. Unless your

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health care provider prescribes it, do *not* take more than 400 micrograms daily. One ounce of Brazil nuts can contain as much as 544 micrograms of selenium. If you take supplemental selenium, do not consume Brazil nuts. If you are pregnant, you should *not* take more than 400 micrograms of supplemental selenium daily, nor should you consume Brazil nuts.

Silicon

Silicon is the second most abundant element on the planet (oxygen is the first). It is necessary for the formation of collagen for bones and connective tissue; for healthy nails, skin, and hair; and for calcium absorption in the early stages of bone formation. It is needed to maintain flexible arteries and plays a major role in preventing cardiovascular disease. Silicon counteracts the effects of aluminum on the body and is important in the prevention of Alzheimer's disease and osteoporosis. It stimulates the immune system and inhibits the aging process in tissues. Silicon levels decrease with aging, so elderly people need larger amounts. A seven-year study of French women showed that higher silicon intakes, primarily from drinking water, appeared to be protective against developing Alzheimer's disease.

Sources

Foods that contain silicon include alfalfa, beets, brown rice, rice bran, rice hulls, whole and rolled oats, bell peppers, soybeans, leafy green vegetables, and whole grains.

Comments

Silicon is most commonly found in the form of silica, a compound of silicon and oxygen also known as silicon dioxide (SiO_2). One form of silicon, called silicic acid (actually, orthosilicic acid, or OSA), appears to be extremely absorbable and useful as a silicon transport agent in the body. Two good sources of silicon are Body Essential Silica Gel from NatureWorks and JarroSil from Jarrow Formulas. The minerals boron, calcium, magnesium, manganese, and potassium are needed for the efficient utilization of silicon.

Sodium

Sodium is necessary for maintaining proper water balance and blood pH. It is also needed for stomach, nerve, and muscle function. Most people consume too much sodium, which can lead to high blood pressure. The main regimen recommended for high blood pressure is called the DASH (Dietary Approaches to Stop Hypertension) diet, one rich in fruits, vegetables, low-fat dairy, and low in saturated fats and cholesterol. Restricting salt intake in addition to following the DASH diet resulted in lower blood pressure levels than simply following the DASH diet alone, according to a study involving more than 400 hypertensive individuals. Although sodium deficiency is rare—most people have adequate (if not excessive) levels of sodium in their bodies—it can occur. This condition is most likely to affect people who take diuretics for high blood pressure, especially if they simultaneously adhere to low-sodium diets.

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Potassium

This mineral is important for a healthy nervous system and a regular heart rhythm. It helps prevent stroke, aids in proper muscle contraction, and works with sodium to control the body's water balance. Potassium is important for chemical reactions within the cells and aids in maintaining stable blood pressure and in transmitting electrochemical impulses. A 1997 review of earlier studies showed that low potassium intake might be a significant factor in the development of high blood pressure. A high intake of potassium protects several body systems, including cardiovascular, renal, and skeletal. The potassium in fruits and vegetables contains organic salts such as malate and citrate, which neutralize the acid urine that can cause kidney stones. Potassium also regulates the transfer of nutrients through cell membranes. This function of potassium has been shown to decrease with age, which may account for some of the circulatory damage, lethargy, and weakness experienced by older people. Together with magnesium, potassium can help prevent calcium oxalate kidney stones.

In one study, healthy individuals with normal blood pressure experienced lower blood pressure from both potassium chloride and potassium citrate. The levels were still normal, but on the lower side of normal, which is desirable. The amount of potassium given in this study was the equivalent of what is found in five half-cup servings of fruits and vegetables. Anyone with high blood pressure would benefit from lowered blood pressure to reduce heart disease risk. In a carefully controlled study in people with high blood pressure, a diet high in salt increased blood pressure and a diet high in potassium lowered it. In each case, subjects received capsules of only 3 grams of added sodium or potassium per day, and the lowering of blood pressure occurred after four weeks in those taking potassium. In another study, consumption of low-sodium, high-potassium, nutrient-rich foods resulted in the lowering of blood pressure after eight weeks. The hypertensive participants in this study consumed three dry packaged meals that needed to be reconstituted with water. The decrease in blood pressure was similar to that obtained by drugs, and unlike drugs, the dietary intervention had no side effects. Some have proposed that consuming a diet that has a potassium-to-sodium ratio of more than 1 is important to help control blood pressure.

Signs of potassium deficiency include abnormally dry skin, acne, chills, cognitive impairment, constipation, depression, diarrhea, diminished reflex function, edema, nervousness, insatiable thirst, fluctuations in heartbeat, glucose intolerance, growth impairment, high cholesterol levels, insomnia, low blood pressure, muscular fatigue and weakness, nausea and vomiting, periodic headaches, proteinuria (protein in the urine), respiratory distress, and salt retention.

Sources

Food sources of potassium include dairy foods, fish, fruit, legumes, meat, poultry, vegetables, and whole grains. High

amounts are found in apricots, avocados, bananas, lima beans, blackstrap molasses, brewer's yeast, brown rice, dates, dulse, figs, dried fruit, garlic, nuts, potatoes, raisins, spinach, torula yeast, wheat bran, winter squash, yams, and yogurt. Herbs that contain potassium include catnip, hops, nettle, plantain, red clover, sage, and skullcap. In general, if it is grown in the ground—for example, fruits and vegetables—it is rich in potassium. In addition, these foods are very low in sodium. It is desirable to consume 2.5 to 3.5 grams of potassium per day from your diet.

Comments

Kidney disorders, diarrhea, and the use of diuretics or laxatives all disrupt potassium levels. Tobacco and caffeine reduce potassium absorption. Using large amounts of licorice over long periods can deplete the body's potassium supply.

Potassium is needed for hormone secretion. The secretion of stress hormones causes a decrease in the potassium-to-sodium ratio both inside and outside the cells. As a result, stress increases the body's potassium requirements.

Too much potassium from supplements could be harmful. Check with your health care professional before using potassium supplements.

Selenium

Selenium's principal function is to inhibit the oxidation of lipids (fats) as a component of the enzyme glutathione peroxidase. It is a vital antioxidant, especially when combined with vitamin E. It protects the immune system by preventing the formation of free radicals that can damage the body. (See ANTIOXIDANTS in Part One.) It plays a vital role in regulating the effects of thyroid hormone on fat metabolism.

Selenium has also been found to function as a preventive against the formation of certain types of tumors. One study found that men who took 200 micrograms of selenium daily over a ten-year period had roughly half the risk of developing lung, prostate, and colorectal cancer as compared with men who did not. Selenium supplementation of 200 micrograms a day reduced inflammation, demonstrated by lowered C-reactive protein levels. Selenium also lowered cholesterol and blood sugar levels in people with Alzheimer's disease. Another group of people with Alzheimer's disease got the selenium and a blend of probiotics. That group experienced improvements in blood measures of lowered oxidation, better blood cholesterol and blood sugar levels, and improved cognitive function.

Selenium and vitamin E act synergistically to aid in the production of antibodies and to help maintain a healthy heart and liver. This trace element is needed for pancreatic function and tissue elasticity. When combined with vitamin E and zinc, it may also provide relief from an enlarged prostate. Selenium supplementation has been found to protect the liver in people with alcoholic cirrhosis. Studies conducted at the University of Miami indicate that taking supplemental selenium may enhance the survival of people with AIDS by increasing both red and white blood cell counts. It has shown promise in the treatment of arthritis,

hops, lemongrass, licorice, mullein, nettle, oat straw, paprika, parsley, peppermint, raspberry leaf, red clover, sage, shepherd's purse, yarrow, and yellow dock.

Comments

The consumption of alcohol, the use of diuretics, diarrhea, the presence of fluoride, and high levels of zinc and vitamin D all increase the body's need for magnesium. The consumption of large amounts of fats, cod-liver oil, calcium, vitamin D, and protein decrease magnesium absorption. Fat-soluble vitamins also hinder the absorption of magnesium, as do foods high in oxalic acid, such as almonds, chard, cocoa, rhubarb, spinach, and tea.

Manganese

Minute quantities of manganese are needed for protein and fat metabolism, healthy nerves, a healthy immune system, and blood sugar regulation. Manganese is used in energy production and is required for normal bone growth and for reproduction. In addition, it is used in the formation of cartilage and synovial (lubricating) fluid of the joints. It is also necessary for the synthesis of bone.

Manganese is essential for people with iron-deficiency anemia and is needed for the utilization of vitamin B₁ (thiamine) and vitamin E. Manganese works well with the B-complex vitamins to give an overall feeling of well-being. It aids in the formation of mother's milk and is a key element in the production of enzymes needed to oxidize fats and to metabolize purines, including the antioxidant enzyme superoxide dismutase (SOD). In a study involving more than 1,000 elderly men, high manganese intake was shown to increase markers of inflammation. The authors acknowledge a need for manganese but observe that too much may have an inflammatory effect in the body.

A deficiency of manganese (which is extremely rare) may lead to atherosclerosis, confusion, convulsions, eye problems, hearing problems, heart disorders, high cholesterol levels, hypertension, irritability, memory loss, muscle contractions, pancreatic damage, profuse perspiration, rapid pulse, teeth grinding, tremors, and a tendency toward breast ailments.

Sources

The largest quantities of manganese are found in avocados, nuts and seeds, seaweed, spinach, and whole grains. This mineral may also be found in blueberries, egg yolks, legumes, dried peas, pineapples, and green leafy vegetables. Herbs that contain manganese include alfalfa, burdock root, catnip, chamomile, chickweed, dandelion, eyebright, fennel seed, fenugreek, ginseng, hops, lemongrass, mullein, parsley, peppermint, raspberry, red clover, rose hips, wild yam, yarrow, and yellow dock.

Molybdenum

This essential mineral is required in extremely small amounts for nitrogen metabolism. It aids in the final stages of the conversion of purines to uric acid. It promotes normal

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cell function, aids in the activation of certain enzymes, and is a component of the metabolic enzyme xanthine oxidase.

Molybdenum is found in the liver, bones, and kidneys. It supports bone growth and strengthening of the teeth. A low intake is associated with mouth and gum disorders and cancer. A molybdenum deficiency may cause impotence in older men. People whose diets are high in refined and processed foods are at risk for deficiency.

Sources

This trace mineral is found in beans, beef liver, cereal grains, dark green leafy vegetables, legumes, and peas.

Comments

Heat and moisture can change the action of supplemental molybdenum. A high intake of sulfur may decrease molybdenum levels. Excess amounts of molybdenum (more than 15 milligrams daily) may interfere with copper metabolism.

Cautions

Do not take more than 15 milligrams of molybdenum daily. Higher doses may lead to the development of gout.

Phosphorus

Phosphorus is needed for blood clotting, bone and tooth formation, cell growth, contraction of the heart muscle, normal heart rhythm, and kidney function. It also assists the body in the utilization of vitamins and the conversion of food to energy. A proper balance of magnesium, calcium, and phosphorus should be maintained at all times. If one of these minerals is present in either excessive or insufficient amounts, this will have adverse effects on the body. When 500 mg of phosphorus was taken with a 648-calorie meal high in carbohydrates, increased energy expenditure was noted in both lean and obese males, and in lean males, there was an increase in fat burning. The combination offers a potential regimen to promote weight loss.

Deficiencies of phosphorus are rare, but can lead to such symptoms as anxiety, bone pain, fatigue, irregular breathing, irritability, numbness, skin sensitivity, trembling, weakness, and weight changes.

Sources

Phosphorus deficiency is rare because this mineral is found in most foods, especially processed cooked foods and carbonated soft drinks. Significant amounts of phosphorus are contained in asparagus; bran; brewer's yeast; corn; dairy products; eggs; fish; dried fruit; garlic; legumes; nuts; sesame, sunflower, and pumpkin seeds; meats; poultry; salmon; and whole grains.

Comments

Excessive amounts of phosphorus interfere with calcium uptake. A diet high in processed cooked foods and junk food such as carbonated beverages is a common culprit. Vitamin D increases the effectiveness of phosphorus.

MINERALS

Potassium

This mineral is and a regular heart proper muscle control the body's w chemical reaction stable blood press impulses. A 1997 potassium intake opment of high bl protects several b nal, and skeletal. contains organic neutralize the aci tassium also regul membranes. This decrease with age culatory damage, older people. Tog help prevent calci In one study, pressure experien tassium chloride still normal, but o sirable. The amou the equivalent of of fruits and veget would benefit from disease risk. In a c high blood pressu pressure and a die case, subjects rece sodium or potassi pressure occurred sium. In another s potassium, nutrien blood pressure afte ipants in this stud that needed to be in blood pressure and unlike drugs, fects. Some have p a potassium-to-sod help control blood Signs of potassi skin, acne, chills, c pression, diarrhea, nervousness, insati glucose intolerance levels, insomnia, l and weakness, nau proteinuria (protei and salt retention.

Sources

Food sources of pot legumes, meat, poul

and should be avoided by everyone; the amount in these products is too low if you are anemic or require iron and too high if you don't need more. If you do need to take iron supplements, do not take them at the same time as vitamin E, and choose an organic form of iron such as ferrous gluconate or ferrous fumarate. Inorganic forms of iron, such as ferrous sulfate, can oxidize vitamin E. The RDA for iron is 8 milligrams per day for adult men, 12 milligrams a day for male children above age ten, and 18 milligrams per day for adult women and girls over eleven years of age (27 milligrams for pregnant women). Combining vitamin E with iron was shown to be beneficial to the microbiome. Iron therapy induces inflammation, which can be mitigated by vitamin E, thereby improving the GI tract. An increase in the genus *Roseburia* (phylum Firmicutes), a butyrate producer, was observed.

There must be sufficient hydrochloric acid (HCl) present in the stomach in order for iron to be absorbed. Copper, manganese, molybdenum, vitamin A, and the B-complex vitamins are also needed for complete iron absorption. Taking vitamin C can increase iron absorption by as much as 30 percent.

Taking calcium with meals can inhibit the absorption of iron from dietary sources. If you are iron deficient, take calcium supplements at bedtime or at other times when you are not consuming foods containing iron. Excessive amounts of zinc and vitamin E can also interfere with iron absorption. The utilization of iron may be impaired by rheumatoid arthritis and cancer. These diseases can result in anemia despite adequate amounts of iron stored in the liver, spleen, and bone marrow. Iron deficiency is more prevalent in people with candidiasis or chronic herpes infections.

Cautions

Do not take iron supplements if you have an infection. Because bacteria require iron for growth, the body "hides" iron in the liver and other storage sites when an infection is present. Taking extra iron at such times encourages the proliferation of bacteria in the body. Iron may cause constipation.

Magnesium

Magnesium is a vital catalyst in enzyme activity, especially the activity of those enzymes involved in energy production. It also assists in calcium and potassium uptake. A deficiency of magnesium interferes with the transmission of nerve and muscle impulses, causing irritability and nervousness. Supplementing the diet with magnesium can help prevent depression, dizziness, muscle weakness and twitching, and premenstrual syndrome (PMS), and also aids in maintaining the body's proper pH balance and normal body temperature.

Magnesium is necessary to prevent the calcification of soft tissue. This essential mineral protects the arterial linings from stress caused by sudden blood pressure changes and plays a role in the formation of bone and in carbo-

hydrate and mineral metabolism. With vitamin B₆ (pyridoxine), magnesium helps to reduce and dissolve calcium phosphate kidney stones and may prevent calcium oxalate kidney stones. Research has shown that magnesium may help prevent cardiovascular disease, osteoporosis, and certain forms of cancer, and it may reduce cholesterol levels. It is effective in preventing premature labor and convulsions in pregnant women.

Studies have shown that taking magnesium supplements during pregnancy has a dramatic effect in reducing birth defects. According to a study reported in the *Journal of the American Medical Association (JAMA)*, there was a 70 percent lower incidence of mental retardation in the children of mothers who had taken magnesium supplements during pregnancy. The incidence of cerebral palsy was 90 percent lower.

Possible manifestations of magnesium deficiency include confusion, insomnia, irritability, poor digestion, rapid heartbeat, seizures, and tantrums; often, a magnesium deficiency can be synonymous with diabetes. Magnesium deficiencies are at the root of many cardiovascular problems. It is possible that magnesium is related to depression. People diagnosed with mild or moderate depression took 248 mg of elemental magnesium as magnesium chloride. After only two weeks, the participants reported feeling happier; this did not occur in the control group. The participants stated that they found the magnesium easy to take. It offered good results quickly and had no major side effects.

Magnesium deficiency may be a major cause of fatal cardiac arrhythmia, hypertension, and sudden cardiac arrest, as well as asthma, chronic fatigue and chronic pain syndromes, depression, insomnia, irritable bowel syndrome, and pulmonary disorders. Research has also shown that magnesium deficiency may contribute to the formation of kidney stones. To test for magnesium deficiency, a procedure called an intracellular (mononuclear cell) magnesium screen should be performed. This is a more sensitive test than the typical serum magnesium screen and can detect a deficiency with more accuracy. Magnesium screening should be a routine test, as a low magnesium level makes nearly every disease worse. It is particularly important for individuals who have or who are considered at risk for developing cardiovascular disease. Muscle biopsies give a better picture of your magnesium status than blood tests do.

Sources

Magnesium is found in most foods, especially dairy products, fish, meat, and seafood. Other rich food sources include apples, apricots, avocados, bananas, black-eyed peas, blackstrap molasses, brewer's yeast, brown rice, cantaloupe, dulse, figs, garlic, grapefruit, green leafy vegetables, kelp, lemons, lima beans, millet, nuts, peaches, potatoes, salmon, sesame seeds, soybeans, tofu, torula yeast, watercress, wheat, and whole grains. Herbs that contain magnesium include alfalfa, bladderwrack, catnip, cayenne, chamomile, chickweed, dandelion, eyebright, fennel seed, fenugreek,

The people in this study followed the diet for two years, showing that the risk of iodine deficiency is possible.

Excessive iodine intake (sometimes as little as 750 micrograms daily) may inhibit the secretion of thyroid hormone and can produce a metallic taste and sores in the mouth, swollen salivary glands, diarrhea, and vomiting. If you have any problem with your thyroid, speak with your physician about iodine. In most cases, however, the small risk of chronic iodine excess is far outweighed by the hazards of a low-iodine diet. It is especially important for women of childbearing age and children to get adequate amounts of iodine.

Sources

Foods that are high in iodine include dairy products (from cattle fed iodine-supplemented feed and salt licks), iodized salt, seafood, saltwater fish, and kelp. It may also be found in asparagus, dulse, garlic, lima beans, mushrooms, sea salt (which provides nature's own balance of minerals), sesame seeds, soybeans, spinach (see Comments, below), summer squash, Swiss chard, turkey, and turnip greens. Most fruits and vegetables grown near the coasts contain more iodine than those grown inland.

Comments

Some foods block the uptake of iodine into the thyroid gland when eaten raw in large amounts. These include Brussels sprouts, cabbage, cauliflower, kale, peaches, pears, spinach, and turnips. If you have an underactive thyroid, you should limit your consumption of these foods.

Iron

Perhaps the most important of iron's functions in the body is the production of hemoglobin and myoglobin (the form of hemoglobin found in muscle tissue), and the oxygenation of red blood cells. Iron is the mineral found in the largest amounts in the blood. It is essential for many enzymes, including catalase, and is important for growth. Iron is also required for a healthy immune system and for energy production.

Iron deficiency is most often caused by insufficient intake. However, it may result from intestinal bleeding, a diet high in phosphorus, poor digestion, long-term illness, ulcers, prolonged use of antacids, excessive coffee or tea consumption, and other causes. Menstruating women may become iron deficient, especially if they have heavy or prolonged periods and/or short menstrual cycles. In some cases, a deficiency of vitamin B₆ (pyridoxine) or vitamin B₁₂ can be the underlying cause of anemia. Strenuous exercise and heavy perspiration also deplete iron from the body. Strict vegetarians are susceptible to iron deficiency and should have regular blood tests to check iron levels. Elite athletes may benefit from supplemental iron. One group of male endurance athletes received 24 milligrams of iron a day and another group got nothing; both engaged in sessions of running on a treadmill over three consecutive days. Those who received the modest doses of iron experi-

enced an increase in hepcidin levels, which indicated better iron absorption.

Iron deficiency symptoms include anemia, brittle hair, difficulty swallowing, digestive disturbances, dizziness, fatigue, fragile bones, hair loss, inflammation of the tissues of the mouth, nails that are spoon-shaped or that have ridges running lengthwise, nervousness, obesity, pallor, and slowed mental reactions. Iron deficiency is present in 30 to 83 percent of people with heart disease. In a retrospective review, only a few were screened (158 out of 10,000) and even fewer were treated with intravenous iron (23 people total). Iron supplementation has been shown to improve heart function and quality of life.

Because iron is stored in the body, excessive iron intake can also cause problems. Too much iron in the tissues and organs leads to the production of free radicals and increases the need for vitamin E. High levels of iron were once thought to be associated with heart disease and cancer. Newer data indicates that having high iron stores does not seem to predict who will get cancer but may predict who will get heart disease. However, ferritin, a protein in the body that binds to iron, was associated with an increased risk of cancer in women when the level was greater than 160 micrograms per liter.

The buildup of iron in the tissues has been associated with a rare disease known as hemochromatosis, a hereditary disorder of iron metabolism that is found mostly in men and postmenopausal women and that causes excessive absorption of iron from both foods and supplements, leading to bronze skin pigmentation, arthritis, cirrhosis of the liver, diabetes, and heart disorders.

Sources

Iron is found in eggs, fish, liver, meat, poultry, green leafy vegetables, whole grains, and enriched breads and cereals. Other food sources with lesser amounts include almonds, avocados, beets, blackstrap molasses, brewer's yeast, dates, dulse, kelp, kidney and lima beans, lentils, millet, peaches, pears, dried prunes, pumpkins, raisins, rice and wheat bran, sesame seeds, soybeans, and watercress. Herbs that contain very small amounts of iron include alfalfa, burdock root, catnip, cayenne, chamomile, chickweed, chicory, dandelion, dong quai, eyebright, fennel seed, fenugreek, kelp, lemongrass, licorice, milk thistle seed, mullein, nettle, oat straw, paprika, parsley, peppermint, plantain, raspberry leaf, rose hips, sarsaparilla, shepherd's purse, uva ursi, and yellow dock. Foods are distinguished between heme iron (only from animal sources) and non-heme sources. The heme iron foods present iron in a form that is more readily absorbed into the body.

Comments

Unless you are diagnosed as anemic, are menstruating or are of childbearing age, you should not take iron supplements. If you take a multivitamin and mineral supplement, choose a product that does not contain iron. Be sure to read labels. Some products contain iron below the

and should products is too high if you supplements, E, and choose conate or fer as ferrous su is 8 milligram for male child for adult wor ligrams for p iron was sho therapy indu vitamin E, th the genus *Rod* ducer, was ob

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Magnesium

Magnesium is a the activity of th It also assists in cy of magnesium and muscle imp Supplementing depression, dizz premenstrual sy ing the body's p peration. Magnesium i soft tissue. This ings from stress and plays a role

went down after four months of receiving 600 mcg daily of chromium picolinate. Longer-term studies are needed to confirm the use of chromium in glucose management.

Some people experience light-headedness or a slight skin rash when taking chromium. If you feel light-headed, stop taking the supplement and consult your health care provider. If you develop a rash, either try switching brands or discontinue use.

Copper

Among its many functions, copper aids in the formation of bone, hemoglobin, and red blood cells, and works in balance with zinc and vitamin C to form elastin, an important skin protein. It is involved in the healing process, energy production, hair and skin coloring, and taste sensitivity.

This mineral is also needed for healthy nerves and joints. One of the early signs of copper deficiency is osteoporosis.

Copper is essential for the formation of collagen, one of the fundamental proteins making up bones, skin, and connective tissue. Other possible signs of copper deficiency include anemia, baldness, diarrhea, general weakness, impaired respiratory function, and skin sores. A lack of copper can also lead to increased blood fat levels. (See COPPER DEFICIENCY in Part Two.)

Excessive intake of copper can lead to toxicity, which has been associated with depression, irritability, nausea and vomiting, nervousness, and joint and muscle pain. Ingesting a quantity as small as 10 milligrams usually causes nausea. A dose of 60 milligrams generally results in vomiting, and just 3.5 grams (3,500 milligrams) can be fatal. Children can be affected at much smaller dosage levels. (See COPPER TOXICITY in Part Two.)

Sources

Besides its use in cookware and plumbing, copper is also widely distributed in foods. Food sources include almonds, avocados, barley, beans, beets, blackstrap molasses, broccoli, garlic, lentils, liver, mushrooms, nuts, oats, oranges, pecans, radishes, raisins, salmon, seafood, soybeans, and green leafy vegetables.

Comments

The level of copper in the body is related to the levels of zinc and vitamin C. Copper levels are reduced if large amounts of zinc or vitamin C are consumed. If copper intake is too high, levels of vitamin C and zinc drop.

The consumption of high amounts of fructose (fruit sugar) can make a copper deficiency significantly worse. In a study conducted by the U.S. Department of Agriculture, people who obtained 20 percent of their daily calories from fructose showed decreased levels of red blood cell superoxide dismutase (SOD), a copper-dependent enzyme critical to antioxidant protection within the red blood cells.

Cautions

Excessive copper in the body can promote destruction of eye tissue through oxidation. Persons with eye problems

should be especially careful to balance their intake of copper with that of iron, zinc, and calcium. In one study, elderly individuals who consumed a high-fat diet, one rich in saturated fat and trans fat, and had high copper intakes (greater than 1.6 milligrams per day) seemed to experience greater cognitive impairment compared to those who ate a diet low in these fats or a diet lower in copper (0.88 mg per day) with high amounts of these dietary fats. In this study, it was best to get copper from foods rather than supplements.

Germanium

Germanium improves cellular oxygenation but is not an essential nutrient. It helps to fight pain, keep the immune system functioning properly, and rid the body of toxins and poisons. Researchers have shown that consuming foods containing organic germanium is an effective way to increase tissue oxygenation, because, like hemoglobin, germanium acts as a carrier of oxygen to the cells. A Japanese scientist, Kazuhiko Asai, found that an intake of 100 to 300 milligrams of germanium per day improved many illnesses, including rheumatoid arthritis, food allergies, elevated cholesterol, candidiasis, chronic viral infections, cancer, and AIDS.

Sources

Germanium is found in all organic material, of both plant and animal origin. The following foods contain the greatest concentrations of germanium: broccoli, celery, garlic, shiitake mushrooms, milk, onions, rhubarb, sauerkraut, tomato juice, and the herbs aloe vera, comfrey, ginseng, and suma.

Comments

Germanium is best obtained through the diet.

Cautions

Although it is rare, some individuals may have a toxic reaction to this mineral if they take it in excessive amounts. People have been known to develop kidney problems, and there have been some deaths associated with germanium. Speak to a health care professional before using it, particularly if you have kidney problems.

Iodine

Needed only in trace amounts, iodine helps to metabolize excess fat and is important for physical and mental development. It is also needed for a healthy thyroid gland and for the prevention of goiter, a grossly swollen gland rarely seen these days. Certain parts of the country have little or no iodine in the soil, and isolated agrarian cultural groups that refrained from using iodized salt and cattle feed were subject to this disorder. Iodine deficiency in children may result in mental retardation. In addition, iodine deficiency has been linked to breast cancer and is associated with fatigue, neonatal hypothyroidism, and weight gain. People following the Paleo diet may develop iodine deficiency. The diet can produce weight loss but eliminates the two major sources of iodine in the diet—table salt and dairy products.

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United States who consumed more than 2½ servings a day of dairy products (about 600 milligrams) had a 32 percent increase in prostate cancer. Studies done in Europe found a relationship between dairy product consumption and the nonaggressive form of prostate cancer but not the aggressive form. The low-fat dairy products were more harmful than those with more fat or than calcium-containing foods that are not dairy products. Dairy products may also lead to an increased risk when used in conjunction with a high-protein diet.

Chromium

Because it is involved in the metabolism of glucose, chromium (sometimes also called glucose tolerance factor, or GTF) is needed for energy. It is also vital in the synthesis of cholesterol, fats, and proteins. This essential mineral maintains stable blood sugar levels through proper insulin utilization and can be helpful both for people with diabetes and those with hypoglycemia. Studies have shown that low plasma chromium levels can be an indication of coronary artery disease. Additional chromium is needed during pregnancy because the developing fetus increases demand for this mineral. Chromium supplements can help an expectant mother maintain healthy blood sugar levels during pregnancy.

The average American diet is chromium deficient. Only one in ten Americans has an adequate amount of chromium in his or her diet. There are five main reasons for this: The form of chromium in many foods is not easily absorbed (only 0.4 to 2.5 percent of dietary chromium is absorbed); not enough foods containing chromium are consumed; much of the chromium content is lost during processing; many people do not like the foods that are the best sources of chromium; and high quantities of sugar in the diet cause a loss of chromium from the body. Researchers estimate that two out of every three Americans have glucose regulation issues including hypoglycemia, pre-hypoglycemia, or diabetes. The ability to maintain normal blood sugar levels is jeopardized by the lack of chromium in our soil and water supply and by a diet high in refined white sugar, flour, and junk foods. A number of human and animal studies have found that chromium supplements can improve insulin sensitivity and blood sugar control in the face of insulin resistance, elevated blood glucose levels, impaired glucose tolerance, and diabetes.

A deficiency of chromium can lead to anxiety, fatigue, glucose intolerance (particularly in people with diabetes), inadequate metabolism of amino acids, and an increased risk of arteriosclerosis. Excessive intake (the level depends upon individual tolerance) can lead to chromium toxicity, which has been associated with dermatitis, gastrointestinal ulcers, and kidney and liver impairment. No toxicities have been reported, and thus chromium does not have an Upper Limit of Safety (UL). (See the chart on page 11 for this book's recommended chromium intake.) As depicted in the movie *Erin Brockovich*, people can become ill from chromium, but it is important to note that this was a different form of the mineral. The form that is

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obtained through diet is called divalent and the one that is toxic is hexavalent.

Supplemental chromium is best absorbed by the body when it is taken in a form called *chromium picolinate* (chromium chelated with picolinate, a naturally occurring amino acid metabolite). Picolinate enables chromium to readily enter into the body's cells, where the mineral can then help insulin do its job much more effectively.

Chromium picolinate has been used successfully to control blood cholesterol and blood glucose levels. The NIH funded a study to look at the benefits of chromium picolinate for patients with diabetes and heart disease. Preliminary data shows it lowers blood sugar and cholesterol. It also promotes the loss of fat and an increase in lean muscle tissue. Studies show it may increase longevity and help to fight osteoporosis. In addition, when combined with biotin, chromium picolinate reduces insulin resistance and reduces "bad" (LDL) cholesterol in patients with type 2 diabetes. Chromium was of benefit to people with a binge-eating disorder. In those given a high dose (1,000 mcg) or lower dose of 600 mcg of chromium picolinate, blood sugar was lowered, body weight went down, and the urge to eat was reduced.

Chromium polynicotinate (chromium bonded to niacin) is an effective form of this mineral as well.

Sources

Chromium is found in the following food sources: beer, brewer's yeast, brown rice, cheese, turkey, fish, and whole grains. It may also be found in apples, bananas, dried beans, blackstrap molasses, broccoli, calf liver, chicken, corn and corn oil, dairy products, dried liver, dulse, eggs, green beans, mushrooms, and potatoes. Herbs that contain chromium include catnip, licorice, nettle, oat straw, red clover, sarsaparilla, wild yam, and yarrow.

Comments

Active, athletic individuals—people who engage in vigorous aerobic activities and consume higher amounts of carbohydrates than the general population—have higher chromium requirements than nonathletes. Chromium levels start to decrease as we age, starting in our early forties. Some smaller studies have confirmed that added chromium in the diet can reduce total body fat and increase the percentage of muscle.

Cautions

If you have insulin-dependent diabetes, you should not use chromium unless your health care practitioner prescribes it. Chromium supplements can make insulin function more effectively and, in effect, reduce insulin requirements. People with diabetes therefore have to monitor their blood sugar levels very carefully when using chromium. Chromium requirements differ from person to person; consult your health care provider to determine the correct amount of this mineral for you. One study showed that in people with poorly controlled type 2 diabetes, blood sugar and hemoglobin A1c

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dock. The amount of calcium in these herbs is so small, however, that they should not be considered as contributing to dietary intake.

Comments

The amino acid lysine is needed for calcium absorption. Food sources of lysine include cheese, eggs, fish, lima beans, milk, potatoes, red meat, soy products, and brewer's yeast. Lysine is also available in supplement form.

Female athletes and menopausal women need greater amounts of calcium than other women because their estrogen levels are lower. Estrogen protects the skeletal system by promoting the deposition of calcium in bone.

Heavy exercising hinders calcium uptake, but moderate exercise promotes it. Insufficient vitamin D intake or the ingestion of excessive amounts of phosphorus and magnesium also hinders the uptake of calcium.

If you are taking medication for osteoporosis, a supplement containing vitamin D and calcium is required to help the medicine work properly. Other types of prescription medicines, such as steroids and anticonvulsants (antiseizure drugs), interfere with bone metabolism, and taking supplemental calcium will help with that.

If calcium is taken with iron, they bind together, preventing the optimal absorption of both minerals. It is therefore best to take calcium and iron at different times. Too much calcium can interfere with the absorption of zinc, and excess zinc can interfere with calcium absorption (especially if calcium intake is low). For most people, the best ratio between supplemental calcium and zinc is up to 2,500 milligrams of calcium with 50 milligrams of zinc daily. A hair analysis can determine the levels of these and other minerals in the body.

A diet that is high in protein, fat, and/or sugar affects calcium uptake. The average American diet of meats, refined grains, and soft drinks (which are high in phosphorus) leads to increased excretion of calcium. Consuming alcoholic beverages, coffee, junk foods, excess salt, and/or white flour also leads to the loss of calcium by the body. A diet based on foods such as vegetables, fruits, and whole grains, which contain significant amounts of calcium but lower amounts of phosphorus, is preferable.

Oxalic acid (found in almonds, beet greens, cashews, chard, cocoa, rhubarb, soybeans, and spinach) interferes with calcium absorption by binding with it in the intestines and producing insoluble salts that cannot be absorbed. The normal consumption of foods containing oxalic acid should not pose a problem, but overindulgence in these foods inhibits the absorption of calcium. Oxalic acid can also combine with calcium to form calcium oxalate kidney stones. Studies have shown, however, that taking magnesium and potassium supplements can prevent the formation of this type of stone.

Calcium supplements are more effective when taken in smaller doses spread throughout the day and before bedtime. This mineral works less effectively when taken in a single megadose. Most experts agree that no more than

500 milligrams should be taken at one time, as this is the maximum amount the body can absorb in one dose. However, because calcium also promotes a sound sleep when taken at night, and because a high-fiber diet can interfere with calcium absorption, some recommend taking a single dose at bedtime. The National Academy of Sciences recommends an intake of at least 1,000 to 1,300 milligrams of calcium per day, particularly for those who have or are at risk of developing osteoporosis. Because the body is more likely to absorb a higher percentage of the calcium when taken in smaller doses, we recommend taking 1,500 to 2,000 milligrams in divided doses with food throughout the day.

Some vitamin companies use a compound called D_3 -calcium phosphate in their products. This form of calcium is insoluble and interferes with the absorption of the nutrients in a multivitamin supplement. Antacids such as Tums are not recommended as a source of calcium. While they do contain calcium, if taken in quantities sufficient to serve as a source of this mineral, they could neutralize the stomach acid needed for calcium absorption. Additionally, a significant percentage (estimates range from 20 to 40 percent) of people over the age of sixty may have a condition called *atrophic gastritis*. This is a chronic inflammation of the stomach, and it reduces the ability to break down the calcium carbonate contained in Tums. People under sixty are more likely to have an overproduction of acid; in that case, calcium carbonate could neutralize some of the excess and reduce the associated symptoms of belching, gas, and bloating.

Since the amount of calcium required per day is large, some people find it difficult to swallow the pills. Chewable versions are available; these are ideal for children who do not meet calcium needs from dairy products. It is best to match the percentage Daily Value for calcium and vitamin D. For example, a good product would have 50 percent DV for calcium and vitamin D in a single unit. Then you can take two or more depending upon your need.

Cautions

Calcium may interfere with the effects of verapamil (Calan, Isoptin, Verelan), a calcium channel blocker sometimes prescribed for heart problems and high blood pressure.

Calcium can also interfere with the effectiveness of tetracycline, thyroid hormone, certain anticonvulsants, and steroids. Consult your health care provider before taking supplemental calcium if you must take any of these drugs.

Phenobarbital and diuretics may cause a deficiency of calcium. Although several major studies have shown that added calcium in the diet does not appear to increase the risk for either a first or a repeat attack of kidney stones, persons with a history of kidney stones or kidney disease should not take calcium supplements except on the advice of a physician. The maximum safe dosage of supplemental calcium is now placed at 2,500 milligrams per day.

Newer data has shown that calcium from dairy and supplements increases the risk of prostate cancer. Men in the

Boron enhances brain function, promotes alertness, and plays a role in how the body utilizes energy from fats and sugars. Most people are not deficient in boron. However, elderly people usually benefit from taking a supplement of 2 to 3 milligrams daily because they have greater problems with calcium absorption. Boron deficiency accentuates vitamin D deficiency.

Boron helps to prevent postmenopausal osteoporosis and build muscle. New research indicates that taking supplemental boron can shrink prostate tumor size, can lower blood levels of prostate-specific antigen (PSA, a marker for prostate cancer), and may help prevent prostate cancer. Boron alleviates joint discomfort by reducing levels of both COX-2 and LOX enzymes (see ARTHRITIS in Part Two) and helps to preserve cognitive function. Studies have shown that in areas of the world where the level of boron in the soil is low, there are a greater number of people suffering from arthritis. A study conducted by the U.S. Department of Agriculture indicated that within eight days of supplementing their daily diet with 3 milligrams of boron, a test group of postmenopausal women lost 40 percent less calcium, one-third less magnesium, and slightly less phosphorus through their urine than they had before beginning boron supplementation. Boron may exert anti-inflammatory properties and be helpful for women with painful menstrual cycles. University students consumed 10 mg per day of boron two days before the onset of their periods and three days while menstruating. When this group was compared to a placebo group, there was no difference in pain between the two, but after the use of boron was completed (two menstrual cycles), the severity and duration of pain was lower.

Sources

Boron is found naturally in apples, carrots, grapes, dark green leafy vegetables, raw nuts, pears, and whole grains.

Cautions

Do not take more than 3 to 6 milligrams of supplemental boron daily unless it is prescribed by a health care professional. Boron is toxic in high doses (15 milligrams or more daily for adults, less for children) but is not carcinogenic or mutagenic. Many supplements for bone health contain 3 milligrams of boron. If you are also using a multivitamin/multimineral supplement, be sure that your total intake through diet and supplements does not exceed 20 milligrams.

Calcium

Calcium is vital for the formation of strong bones and teeth and for the maintenance of healthy gums. It is also important in the maintenance of a regular heartbeat and in the transmission of nerve impulses. Calcium lowers cholesterol levels and helps prevent cardiovascular disease. It is needed for muscular growth and contraction, and for the prevention of muscle cramps. It may increase the rate of bone growth and bone mineral density in children. Calcium from dairy products or supplements has been shown to

promote weight loss, especially in terms of fat loss. However, these findings are not universally accepted. Supplemental calcium of 500 mg daily helped improve bone mass in postmenopausal women aged fifty to seventy-five. Even for women who did not regularly engage in physical activity, supplemental calcium reduced the loss of bone mass in the spine and hips. Exercise has a protective effect against bone loss, but supplemental calcium seemed to help preserve the bones even without it. A combination of calcium and vitamin D was shown to promote weight loss in a group of obese women. Women were assigned to a weight loss diet, and some were prescribed supplements of weekly vitamin D of 1,250 mcg (50,000 IU) and daily calcium of 1,200 mg. They were all deficient in vitamin D at the start of the study. After three months, these women experienced significant weight loss and reduction of waist circumference.

This important mineral is also essential in blood clotting and helps prevent cancer. It may lower blood pressure and prevent the bone loss associated with osteoporosis as well. Calcium provides energy and participates in the protein structuring of RNA and DNA. It is also involved in the activation of several enzymes, including lipase, which breaks down fats for utilization by the body. In addition, calcium maintains proper cell membrane permeability, aids in neuromuscular activity, helps keep the skin healthy, and protects against the development of preeclampsia during pregnancy, the number one cause of maternal death. If high blood pressure develops due to pregnancy, it can be reduced by calcium intake.

Calcium protects the bones and teeth from lead by inhibiting absorption of this toxic metal. If there is a calcium deficiency, lead can be absorbed by the body and deposited in the teeth and bones.

Calcium deficiency can lead to the following problems: aching joints, brittle nails, eczema, elevated blood cholesterol, heart palpitations, hypertension (high blood pressure), insomnia, muscle cramps, nervousness, numbness in the arms and/or legs, a pasty complexion, rheumatoid arthritis, rickets, and tooth decay. Deficiencies of calcium are also associated with cognitive impairment, convulsions, depression, delusions, and hyperactivity.

Sources

Calcium is found in dairy foods, salmon (with bones), sardines, seafood, and dark green leafy vegetables. Other food sources include almonds, asparagus, blackstrap molasses, brewer's yeast, broccoli, buttermilk, cabbage, cantaloupe, cheese, collards, dandelion greens, dulse, figs, filberts, goat's milk, kale, kelp, milk, mustard greens, oats, prunes, sesame seeds, soybeans, tofu, turnip greens, watercress, whey, and yogurt.

Herbs that contain calcium include alfalfa, burdock root, cayenne, chamomile, chickweed, chicory, dandelion, eyebright, fennel seed, fenugreek, flaxseed, hops, lemon grass, mullein, nettle, oat straw, paprika, parley, peppermint, plantain, raspberry leaves, red clover, rose hips, shepherd's purse, violet leaves, yarrow, and yellow

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Comments

The amino acids. Food sources of milk, potatoes, Lysine is also a

Female athletes. amounts of calcium levels are low by promoting the

Heavy exercise. exercise promotes ingestion of excess calcium also hinders

If you are taking a supplement containing the medicine with medicines, such as diuretic drugs, interfere with supplemental calcium

If calcium is taken in excess, venting the opportunity therefore best to take too much calcium, zinc, and excess calcium (especially if the best ratio between calcium to 2,500 milligrams daily. A hair analysis of other minerals in the

A diet that is high in calcium uptake. The refined grains, and some (such as corn) leads to increased alcoholic beverages. white flour also leads to a diet based on food grains, which contain lower amounts of phosphorus

Oxalic acid (found in chard, cocoa, rhubarb) with calcium absorption and producing insoluble compounds. normal consumption does not pose a problem, but it inhibits the absorption of calcium. Studies have shown that potassium supplements can help prevent type of stone

Calcium supplements in smaller doses spread over time. This mineral works in a single megadose. Most

strengthens the heart muscle) and high blood pressure, and also to enhance the immune system. Research in Japan has shown that coenzyme Q_{10} also protects the stomach lining and duodenum, and may help heal duodenal ulcers.

The amount of coenzyme Q_{10} present in the body declines with age, so it should be supplemented in the diet, especially by people who are over the age of fifty. Nature's Plus and Carlson Labs both make soft gel capsules of coenzyme Q_{10} in dosage levels up to 300 milligrams. Oil-based forms are best.

Sources

Mackerel, salmon, and sardines contain the largest amounts of coenzyme Q_{10} . It is also found in beef, peanuts, and spin-

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ach. People consume about 10 to 15 milligrams a day, mainly from meat and fish. Vegetarians should be aware that their intake may be less than optimal and should consider supplementation.

Comments

Coenzyme Q_{10} is oil soluble and is best absorbed when taken with oily or fatty foods, such as fish. Be cautious when purchasing coenzyme Q_{10} . Not all products offer it in its purest form. Its natural color is dark bright yellow to orange, and it has very little taste in the powdered form. It should be kept away from heat and light. Pure coenzyme Q_{10} is perishable and deteriorates in temperatures above 115°F. A liquid or oil form is preferable.

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bone density in women. Supplementing the diet with this vitamin enhances the bone-building process by attracting calcium to the bone. Supplemental vitamin K also reduces the amount of calcium in the urine and frees up more calcium to be used by the bone-building process.

Cautions

Do not take large doses of synthetic vitamin K during the last few weeks of pregnancy. It can result in a toxic reaction in the newborn. If you are taking anticoagulant (blood-thinning) drugs, consult with your health care provider before taking any supplemental vitamin K, as it can interfere with the action of these medications. Megadoses of this vitamin can accumulate in the body and cause flushing and sweating.

Bioflavonoids

Although bioflavonoids are not true vitamins in the strictest sense, they are sometimes referred to as vitamin P. Bioflavonoids are essential for the absorption of vitamin C, and the two should be taken together. There are many different bioflavonoids, including citrin, eriodictyol, flavones, hesperetin, hesperidin, quercetin, quercitrin, and rutin. The human body cannot produce bioflavonoids, so they must be supplied in the diet.

Bioflavonoids are used extensively in the treatment of athletic injuries because they relieve pain, bumps, and bruises. They also reduce pain located in the legs or across the back, and lessen symptoms associated with prolonged bleeding and low serum calcium. Bioflavonoids act synergistically with vitamin C to protect and preserve the structure of capillaries. In addition, bioflavonoids have an antibacterial effect and promote circulation, stimulate bile production, lower cholesterol levels, and treat and prevent cataracts. When taken with vitamin C, bioflavonoids also reduce the symptoms of oral herpes.

Quercetin, a bioflavonoid available in supplement form, may effectively treat and prevent asthma symptoms. Activated Quercetin from Source Naturals is a good source of quercetin. It also contains two other ingredients that increase its efficacy: bromelain, an enzyme from pineapple, and vitamin C, in the nonacidic form of magnesium ascorbate. Bromelain and quercetin are synergists and should be taken in conjunction to enhance absorption.

Sources

Peppers, buckwheat, black currants, and the white material just beneath the peel of citrus fruits contain bioflavonoids. Sources of bioflavonoids include apricots, blackberries, cherries, grapefruit, grapes, lemons, oranges, plums, and prunes. Herbs that contain bioflavonoids include chervil, elderberries, hawthorn berry, rose hips, and shepherd's purse.

Comments

Extremely high doses of bioflavonoids may cause diarrhea.

Coenzyme Q₁₀

Coenzyme Q₁₀ is a vitamin-like substance found in all parts of the body, the action of which resembles that of vitamin E. It may be an even more powerful antioxidant. It is also called ubiquinone. There are ten common substances designated coenzyme Qs, but coenzyme Q₁₀ is the only one found in human tissue. This substance plays a critical role in the production of energy in every cell of the body. It aids circulation, stimulates the immune system, increases tissue oxygenation, and has vital antiaging effects. Deficiencies of coenzyme Q₁₀ have been linked to periodontal disease, diabetes, and muscular dystrophy.

Research has revealed that supplemental coenzyme Q₁₀ has the ability to counter histamine, and therefore is beneficial for people with allergies, asthma, or respiratory disease. Many people also use it when taking cholesterol-lowering drugs in the statin family to reduce leg cramps. Medical literature does not support this practice, but coenzyme Q₁₀ is not harmful and there is enough anecdotal information that it may relieve cramping, so it can't hurt to try it.

Coenzyme Q₁₀ is used by many health care professionals to treat anomalies of mental function, such as those associated with schizophrenia and Alzheimer's disease. It is also beneficial in fighting obesity, candidiasis, multiple sclerosis, and diabetes. Other conditions—such as heart disease, migraines, and Parkinson's disease—are related to a defect in the body's ability to turn food into energy, and coenzyme Q₁₀ may help. Autism is thought to be caused in part by oxidative stress, and coenzyme Q₁₀ may be beneficial. Children with autism spectrum disorders who took 60 mg daily experienced a reduction in oxidative stress in the blood and improvements in sleep and gastrointestinal symptoms.

Coenzyme Q₁₀ appears to be a giant step forward in the treatment and prevention of cardiovascular disease. A six-year study conducted by scientists at the University of Texas found that people being treated for congestive heart failure who took coenzyme Q₁₀ in addition to conventional therapy had a 75 percent chance of survival after three years, compared with a 25 percent survival rate for those using conventional therapy alone. In a similar study by the University of Texas and the Center for Adult Diseases in Japan, coenzyme Q₁₀ was shown to be able to lower high blood pressure without medication or dietary changes. For patients over sixty-five years of age receiving kidney dialysis three times each week, coenzyme Q₁₀ reduced a marker of oxidative stress (F₂-isoprostane). After four months, those taking 1,200 mg of coenzyme Q₁₀, but not those taking 600 mg, experienced this reduction in oxidative stress.

In addition to its use in fighting cardiovascular disease, coenzyme Q₁₀ has been shown to be effective in reducing mortality in experimental animals afflicted with tumors and leukemia. Some doctors give their patients coenzyme Q₁₀ to reduce the side effects of cancer chemotherapy.

Coenzyme Q₁₀ is widely used in Japan. More than 12 million people in that country are reportedly taking it at the direction of their physicians for treatment of heart disease (it

than the synthetic form. Synthetic vitamin E is only 67 percent as active as the natural form. Read labels closely. The natural form of vitamin E is listed as *d-alpha-tocopherol*, *rrr-alpha-tocopherol*, *d-alpha-tocopherol acetate*, or *d-alpha-tocopherol succinate*. The synthetic form is listed as *dl-alpha-tocopherol* or *all-rac alpha-tocopherol* (watch out for the *l* after the *d*). The synthetic form costs only about half as much as the natural form, but it has significantly less activity, or potency. Some vitamin manufacturers have been known to mix 10 percent natural and 90 percent synthetic vitamin E, then label the product *natural*. Your responsibility is to check the label and make sure it says 100 percent potency or 100 percent natural vitamin E.

If you cannot absorb fat, there is a special water-soluble form of vitamin E available from various suppliers.

Sources

Vitamin E is found in the following food sources: avocados, cold-pressed vegetable oils (olive, soybean, corn, canola, safflower, and sunflower), dark green leafy vegetables, fortified cereals, legumes, nuts (almonds, hazelnuts, peanuts), seeds, and whole grains. Significant quantities of this vitamin are also found in brown rice, cornmeal, dulse, eggs, kelp, desiccated liver, milk, oatmeal, organ meats, soybeans, sweet potatoes, watercress, wheat, and wheat germ. Herbs that contain vitamin E include alfalfa, bladderwrack, dandelion, dong quai, flaxseed, nettle, oat straw, raspberry leaf, and rose hips.

Comments

The body needs zinc in order to maintain the proper level of vitamin E in the blood. Vitamin E that has oxidized a free radical can be revitalized by vitamin C and enabled to battle additional free radicals, according to Lester Packer, Ph.D., who was a noted researcher and professor of molecular and cell biology at the University of California-Berkeley. Adding vitamin E to fats and oils prevents them from becoming rancid. The oxidation of fats is a key factor in the formation of plaque adhering to blood vessel walls.

If you take both vitamin E and iron supplements, take them at different times of the day. Inorganic forms of iron (such as ferrous sulfate) destroy vitamin E. Organic iron (ferrous gluconate or ferrous fumarate) leaves vitamin E intact.

Cautions

If you are taking an anticoagulant medication (blood thinner), do not take more than 90 milligrams (200 IU) of vitamin E daily. If you suffer from diabetes, rheumatic heart disease, or an overactive thyroid, do not take more than the recommended dose. If you have high blood pressure, start with a small amount, such as 45 milligrams (100 IU), and increase slowly to the desired amount. If you have retinitis pigmentosa that is not associated with vitamin E deficiency, do not take any supplemental vitamin E.

Vitamin K

Vitamin K is needed for the production of prothrombin, which is necessary for blood clotting. It is also essential for

bone formation and repair; it is necessary for the synthesis of osteocalcin, the protein in bone tissue on which calcium crystallizes. Consequently, it may help prevent osteoporosis. In addition, it may protect the vascular system by preventing calcification in the arteries. The liver is a very efficient extractor of vitamin K, which it uses to make clotting factors for the blood. Investigators from the Netherlands have argued that the current DRIs may be insufficient to meet the needs of other tissues in the body. The recommendations were based on the amount of vitamin K needed to clot blood, and other tissues do not have enough. The problem becomes more acute in those over forty years of age.

Vitamin K plays an important role in the intestines and aids in converting glucose into glycogen for storage in the liver, promoting healthy liver function. It may increase resistance to infection in children and help prevent cancers that target the inner linings of the organs. It aids in promoting longevity. A deficiency of this vitamin can cause abnormal and/or internal bleeding.

There are three forms of vitamin K. The first is vitamin K₁ (phylloquinone or phytonadione), which comes from plants and makes up your dietary vitamin K. The second is vitamin K₂, a family of substances called menaquinones, which are made by intestinal bacteria and also found in butter, cow liver, chicken, egg yolks, fermented soybean products, and some cheeses. Third, there is vitamin K₃ (menadiolone), which is a synthetic substance.

Sources

Vitamin K₁ is found in some foods, including asparagus, blackstrap molasses, broccoli, Brussels sprouts, cabbage, cauliflower, chicken, dark green leafy vegetables, egg yolks, leaf lettuce, liver, oatmeal, oats, rye, safflower oil, soybeans, wheat, and yogurt. Herbs that can supply vitamin K include alfalfa, green tea, kelp, nettle, oat straw, and shepherd's purse. However, the majority of the body's supply of this vitamin is synthesized by the "friendly" bacteria normally present in the intestines, which comes as a result of consuming soluble fiber.

Comments

Antibiotics increase the need for dietary or supplemental vitamin K. Because bacteria in the intestines synthesize vitamin K, taking antibiotics—which kill the bacteria—interferes with this process. Antibiotics also interfere with the absorption of vitamin K. Vitamin K deficiency can be caused by any of the following:

- A poor or restricted diet lacking in fiber.
- Crohn's disease, ulcerative colitis.
- Liver disease that interferes with vitamin K storage.
- The use of antibiotics, cholesterol-lowering drugs, mineral oil, aspirin, and/or blood thinners.

Low levels of vitamin K are associated with insulin resistance and glucose regulation problems, and may lead to low

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tigious *New England Journal of Medicine* showed no benefit from taking large amounts of vitamin D. In a study of more than 25,000 people followed for more than five years, taking vitamin D (50 mg; 2,000 IU) and omega-3 fatty acids (1 gram) did not reduce the risk of invasive cancer or of a variety of conditions associated with heart disease.

Vitamin E

Vitamin E is actually a family of eight antioxidant compounds. These consist of four tocopherols (alpha, beta, gamma, and delta) and four tocotrienols (also alpha through delta). The alpha-tocopherol form is the one found in the largest quantities in human blood and tissue. Small amounts of the gamma form are also found.

Alpha-tocopherol acts as an antioxidant in the human body. As an antioxidant, vitamin E prevents cell damage by inhibiting the oxidation of lipids (fats) and the formation of free radicals. It protects other fat-soluble vitamins from destruction by oxygen and aids in the utilization of vitamin A. It protects the low-density lipoproteins (LDL cholesterol) from oxidation as well. Oxidized LDL has been implicated in the development of cardiovascular disease. It is also known to inhibit blood platelet aggregation (clotting) and has other functions related to the activity of the immune system.

Vitamin E is essential for life, and Americans typically don't get enough of it from their diet. Only 8 percent of men and 2.4 percent of women consume the amount the government recommends. You at least need the DRI for vitamin E, and perhaps more. It is hard to get this nutrient from foods alone, so supplementation is recommended. We don't recommend taking unsafe doses—that is, doses in excess of the UL of safety. None of the dosages given in previous editions of this book seriously exceed the maximums (upper levels or ULs) published by the Office of Dietary Supplements at the National Institutes of Health. These upper limits were established based on the possibility of hemorrhage rather than any perceived problem with the vitamin itself.

The most common dietary form of vitamin E is the gamma-tocopherol form. However, this form is not taken up by the body in any quantity because the liver selectively incorporates alpha-tocopherol into blood lipoproteins for delivery to the tissues. About ten times more alpha-tocopherol than gamma-tocopherol is found in the blood. However, the gamma form may have some unique benefits in suppressing colon cancer, according to recent animal studies, making a sufficient amount of dietary vitamin E even more important to good health.

Vitamin E deficiency may result in damage to red blood cells and destruction of nerves. Signs of deficiency can include infertility (in both men and women), menstrual problems, neuromuscular impairment, shortened red blood cell life span, spontaneous abortion (miscarriage), and uterine degeneration. People with impaired balance and coordination and/or damage to the retina (pigmented retinopathy) may also be deficient. Individuals with se-

vere malnutrition, genetic defects affecting a liver protein known as alpha-tocopherol transfer protein (alpha-TTP), or fat malabsorption problems such as those caused by cystic fibrosis, cholestatic liver disease, or Crohn's disease may have a vitamin E deficiency. True vitamin E deficiency is rare, but low intake (lower than required) is relatively common. One study showed that 27 to 41 percent of people studied had blood levels of alpha-tocopherol less than 20 micromoles per liter ($\mu\text{moles/L}$), the level below which there appears to be an increased risk for cardiovascular disease. Low levels of vitamin E in the body have been linked to both bowel cancer and breast cancer.

THE VITAMIN E CONTROVERSY

A common complaint among consumers of nutritional information is that researchers are always changing their minds about what is good for you. The problem is that two different studies using the same nutrient have the potential to produce contradictory data. This is because nutrients are consumed in varying amounts, making it almost impossible to determine the exact intake of a single compound. Moreover, the only way to completely isolate a nutrient for study would be to remove it entirely, and this would risk making the person ill. Vitamin E serves as a perfect example of these challenges and why there is often conflicting data among nutritional research studies. In 2004, a group of researchers reported that consuming vitamin E in supplement form in excess of 90 mg (200 IU) per day actually increased the chances of dying. Previous studies, and these were numerous, had been fairly unanimous in their findings that 180 mg (400 IU) of vitamin E actually reduced the risk of heart disease and prostate cancer. How is it possible that researchers came up with such different conclusions about the same vitamin? First, in the 2004 study, participants were rarely given vitamin E on its own. Usually it was given with beta-carotene and vitamin C. Other studies have shown that beta-carotene increases the risk of death in smokers. So some of the increased risk of death attributed to vitamin E was likely related to smokers who took both nutrients. Second, the study included all forms of vitamin E. Sometimes vitamin E was given as alpha-tocopherol and sometimes as mixed tocopherols, and since each has distinct biological effects, they cannot be lumped together. This is an important point, echoed over the past several years. Vitamin E in the form of tocotrienols have a greater antioxidant and anti-inflammatory effect than vitamin E in the tocopherol form. In the future, different forms of vitamin E will likely be identified that reduce cancer risk and support healthy bones, eyes, the heart, and the nervous system. Third, because most participants were over sixty and a majority had preexisting conditions, such as heart disease, the study's application to younger, healthy adults may be limited.

The d-alpha-tocopherol form of vitamin E is the most potent and is the one we recommend. Also, natural sources of vitamin E are better than synthetic vitamin E because natural vitamin E is more available for use by the body.

related to reduced muscle mass and potentially increased fatigue. It is possible that vitamin C may be recommended to people with sarcopenia (i.e., muscle wasting in the elderly).

If you are pregnant, do not take more than 2,000 milligrams of vitamin C daily. A developing infant may become dependent on this supplement and develop scurvy when deprived of the accustomed megadoses after birth. If you have a bruise or sprained muscle, temporarily cut back on vitamin C to less than 90 milligrams daily. Larger amounts may combine with iron produced by the injuries to cause more damage.

Avoid using chewable vitamin C supplements, because these can damage tooth enamel.

Vitamin D

Vitamin D, a fat-soluble vitamin that has properties of both a vitamin and a hormone, is required for the absorption and utilization of calcium and phosphorus. It is necessary for growth and is especially important for the normal growth and development of bones and teeth in children. It protects against muscle weakness and is involved in regulation of the heartbeat. It is also important in the prevention and treatment of breast and colon cancer, osteoarthritis, osteoporosis, and hypocalcemia; enhances immunity; and is necessary for thyroid function and normal blood clotting.

There are several forms of vitamin D, including vitamin D₂ (ergocalciferol), which comes from food sources; vitamin D₃ (cholecalciferol), which is synthesized in the skin in response to exposure to the sun's ultraviolet rays; and a synthetic form identified as vitamin D₅. Of the three, vitamin D₃ is considered the natural form of vitamin D and was thought to be the most active. Newer data show that D₂ is as effective as D₃ in maintaining vitamin D levels in the blood.

The form of vitamin D that we get from food or supplements is not fully active. It requires conversion by the liver, and then by the kidneys, before it becomes fully active. This is why people with liver or kidney disorders are at a higher risk for osteoporosis. When the skin is exposed to the sun's ultraviolet rays, a cholesterol compound in the skin is transformed into a precursor of vitamin D. Exposing the face and arms to the sun for fifteen minutes three times a week is an effective way to ensure adequate amounts of vitamin D in the body.

Vitamin D has been the ignored vitamin until recently. Studies have shown that at least 40 percent of people have less-than-optimal levels of the vitamin in their blood. As many as 70 to 80 percent of Hispanic Americans and African Americans may be deficient in vitamin D. Those with more coloring in the skin have a harder time absorbing vitamin D from sunlight. In addition, those who live above the 37th latitude obtain virtually no vitamin D from sunlight between November and March.

Not getting enough vitamin D in the diet or from direct sunlight has been linked to the development of several diseases including heart disease, osteoporosis, diabetes, and

cancers such as breast and colon. As baby boomers age, the risk of osteoporosis increases. Taking more than 10 mcg (400 IU) of vitamin D has been shown to reduce the risk of fractures by 20 percent in those over sixty-five years of age. But how much is needed to optimize health is still open for debate. Some have argued that it is necessary to consume very high amounts of vitamin D—in excess of the UL for safety—in order to maintain blood levels associated with reducing the risk of disease. Before the FDA considers increasing the UL for vitamin D, more research is needed to assure that there is no risk of toxicity at the upper levels. We do not recommend exceeding the UL for vitamin D until further research has been conducted. The FDA took a different approach and doubled the daily value that should be consumed. Now we should consume 20 mcg daily (800 IU). Around Europe, people with low vitamin D levels were more likely to contract the coronavirus. The lowest levels were seen in the elderly. If COVID-19 is contracted, the severity of the disease may be mitigated with adequate blood vitamin D levels. Vitamin D helps reduce inflammation and reduces the risk of upper respiratory infections and pneumonia, which can occur with the coronavirus. It is best to determine your own blood vitamin D level so you can determine how much, if any, to take as a supplement.

Sources

Fish liver oils, fatty saltwater fish (especially mackerel), dairy products, and eggs all contain vitamin D. It is also found in butter, cod-liver oil, dandelion greens, egg yolks, halibut, liver, milk, shiitake and chanterelle mushrooms, oatmeal, oysters, pork, salmon, sardines, sweet potatoes, tuna, and vegetable oils. Herbs that contain vitamin D include alfalfa, nettle, and parsley. Vitamin D is added to some foods, including orange juice, margarine, and dairy products.

Vitamin D is also formed by the body in response to the action of sunlight on the skin. Of all the nutrients, this is one of a few that is difficult to reach the DRI from food alone and supplementation may be needed. It may make sense to take serial blood tests each year with a physical examination to see if you are getting enough vitamin D to maintain healthy levels.

Comments

Intestinal disorders and liver and gallbladder malfunctions interfere with the absorption of vitamin D. Some cholesterol-lowering drugs, antacids, mineral oil, and steroid hormones such as cortisone also interfere with absorption.

Thiazide diuretics such as chlorothiazide (Diuril) and hydrochlorothiazide (Esidrix, HydroDIURIL, Oretic) disturb the body's calcium/vitamin D ratio. Taking excessive amounts of vitamin D (over 25 mg; 1,000 IU) daily may cause a decrease in bone mass.

Cautions

Toxicity may result from taking excessive amounts of supplemental vitamin D. A seminal study reported in the pres-

that grows in the stomach and may result in pain, gas, and bloating. Using 1,000 milligrams of vitamin C, in combination with drugs to treat the condition, allowed for less of the drugs to be used, which resulted in a cost savings to the patients. Because vitamin C has immunomodulation and antimicrobial functions, a study has been designed for patients with the coronavirus who are in the intensive care unit. Investigators in China believe that this therapy will boost immune function and help overcome the damage to the lungs that occurs with this condition.

Vitamin C works synergistically with both vitamin E and beta-carotene—that is, when these vitamins work together, they have an effect even greater than the sum of their individual effects, and taking them together may counter the potentially adverse effects of taking these vitamins alone. Long-term users of vitamins E and C in combination seem to have higher cognitive abilities as they age, as reported by a 2003 study.

Vitamin E scavenges for dangerous free radicals in cell membranes, while vitamin C attacks free radicals in biologic fluids. These vitamins reinforce and extend each other's antioxidant activity.

Because the body cannot manufacture vitamin C, it must be obtained through the diet or in the form of supplements.

It was once thought that most of the vitamin C consumed in the diet was lost in the urine, although this idea is being challenged because initial studies apparently failed to account for the half-life, or consistent decreasing rate of elimination from the blood, of the vitamin in the original calculations.

If you require larger-than-normal amounts of vitamin C due to serious illness, such as cancer, it is more effective to take it intravenously, under the supervision of a physician, than it is to take high doses orally.

Scurvy is a disease caused by vitamin C deficiency. It is characterized by poor wound healing, soft and spongy bleeding gums, edema, extreme weakness, and "pinpoint" hemorrhages under the skin. Fortunately, this condition is rare in Western societies. More common are signs of lesser degrees of deficiency, including gums that bleed when brushed; increased susceptibility to infection, especially colds and bronchial infections; joint pains; lack of energy; poor digestion; prolonged wound healing time; a tendency to bruise easily; and tooth loss.

Sources

Vitamin C is found in berries, citrus fruits, and green vegetables. Good sources include asparagus, avocados, beet greens, black currants, broccoli, Brussels sprouts, cantaloupe, collards, dandelion greens, dulse, grapefruit, kale, lemons, mangoes, mustard greens, onions, oranges, papayas, green peas, sweet peppers, persimmons, pineapple, radishes, rose hips, spinach, strawberries, Swiss chard, tomatoes, turnip greens, and watercress. Orange juice is an excellent source of vitamin C, but only if it is freshly squeezed or has been processed by methods that don't involve heating or

pasteurization. While freshly squeezed juice is best, frozen juices are often processed by nonthermal methods and can be good sources of vitamin C. Some so-called fruit drinks have added vitamin C, and although they are not as good a choice as real fruit juices, they are preferable to carbonated beverages that are devoid of any nutrients.

Herbs that contain vitamin C include alfalfa, burdock root, cayenne, chickweed, eyebright, fennel seed, fenugreek, hops, kelp, peppermint, mullein, nettle, oat straw, paprika, parsley, pine needle, plantain, raspberry leaf, red clover, rose hips, skullcap, violet leaves, yarrow, and yellow dock.

Comments

Alcohol, analgesics, antidepressants, anticoagulants, oral contraceptives, and steroids may reduce levels of vitamin C in the body. Smoking causes a serious depletion of vitamin C.

Diabetes medications such as chlorpropamide (Diabinese) and sulfa drugs may not be as effective if taken with vitamin C. Taking high doses of vitamin C may cause a false-negative reading in tests for blood in the stool. It is thought that for some people taking too much vitamin C may cause it to act as a prooxidant (creating damaging oxygen particles) rather than an antioxidant (negating the harmful effect of oxygen free radicals). For example, patients with kidney failure had increased oxidation of tissues by taking only 214 milligrams per day.

For maximum effectiveness, supplemental vitamin C should be taken in divided doses, twice daily. Esterified vitamin C (Ester-C) is an effective form of vitamin C. Recently, however, some investigators have found that Ester-C may be no more bioavailable than regular vitamin C (ascorbic acid). We will have to wait to see what is discovered in future studies. Ester-C is created by having the vitamin C react with a necessary mineral, such as calcium, magnesium, potassium, sodium, or zinc. This results in a form of the vitamin that is nonacidic and that contains vitamin C metabolites identical to those produced by the body. Esterified vitamin C enters the bloodstream and tissues four times faster than standard forms of vitamin C because it moves into the blood cells more efficiently and also stays in the body tissues longer. The levels of vitamin C in white blood cells achieved by taking esterified vitamin C are four times higher than those achieved with standard vitamin C. Further, only one-third as much is lost through excretion in the urine. A variety of manufacturers produce supplements containing Ester-C, either by itself or in combination with other valuable nutrients, including the antioxidants Pycnogenol and proanthocyanidins, and the herbs echinacea and garlic.

Cautions

If aspirin and standard vitamin C (ascorbic acid) are taken together in large doses, stomach irritation can occur, possibly leading to ulcers. If you take aspirin regularly, use an esterified form of vitamin C, and take it separately from the aspirin. With aging, vitamin C intake may decline, which is

Comments

Oral contraceptives may increase the need for folate. Alcohol also can act as an enemy to folate absorption.

Cautions

Do not take high doses of folate for extended periods if you have a hormone-related cancer or seizure disorder.

Inositol

Inositol is vital for hair growth. This vitamin has a calming effect and helps to reduce cholesterol levels. It helps prevent hardening of the arteries and is important in the formation of lecithin and the metabolism of fat and cholesterol. It also helps remove fats from the liver. Deficiency can lead to arteriosclerosis, constipation, hair loss, high blood cholesterol, irritability, mood swings, and skin eruptions. Research has also shown that high doses of inositol may help in the treatment of depression, obsessive-compulsive disorder, and anxiety disorders, without the side effects of prescription medications. Inositol coupled with alpha-lipoic acid may help insulin work better, meaning a faster removal of sugar from the blood. Postmenopausal women experienced a 20 percent drop in insulin resistance measured via HOMA, a sophisticated test to see how well insulin works in the body (lower is better).

Sources

Inositol is found in brewer's yeast, fruits, lecithin, legumes, meats, milk, unrefined molasses, raisins, vegetables, and whole grains.

Comments

Consuming large amounts of caffeine may cause a shortage of inositol in the body.

Para-Aminobenzoic Acid (PABA)

PABA is one of the basic constituents of folate and also helps in the assimilation of pantothenic acid. PABA can be converted into folate by intestinal bacteria. This antioxidant helps protect against sunburn by reducing the absorption of ultraviolet-B (UV-B) radiation. Consequently, it helps to prevent skin cancer. It also acts as a coenzyme in the breakdown and utilization of protein; and assists in the formation of red blood cells.

PABA also aids in the maintenance of healthy intestinal flora. Supplementing the diet with PABA may restore gray hair to its original color if the graying was caused by stress or a nutritional deficiency. Other benefits of PABA include protection against secondhand smoke, ozone, and other air pollutants; reduced inflammation in arthritis; and enhanced flexibility.

A deficiency of PABA may lead to depression, fatigue, gastrointestinal disorders, graying of the hair, irritability, nervousness, and patchy areas of white skin.

Sources

Foods that contain PABA include kidney, liver, molasses, mushrooms, spinach, and whole grains.

Comments

Sulfa drugs may cause a deficiency of PABA.

Vitamin C (Ascorbic Acid)

Vitamin C is an antioxidant that is required for at least three hundred metabolic functions in the body, including tissue growth and repair, adrenal gland function, and healthy gums. It also aids in the production of antistress hormones and interferon, an important immune system protein, and is needed for the metabolism of folic acid, tyrosine, and phenylalanine. Studies have shown that taking vitamin C can reduce symptoms of asthma. It protects against the harmful effects of pollution, helps to prevent cancer, protects against infection, and enhances immunity. Vitamin C increases the absorption of iron. It can combine with toxic substances, such as certain heavy metals, and render them harmless so that they can be eliminated from the body.

Most people know of vitamin C and its perceived ability to prevent the common cold. But over the years there has been conflicting data on vitamin C and its effect on colds. And the data remains conflicting. A group of researchers with the Cochrane Collaboration Reviews, the largest medical literature database, looked at the effect of vitamin C and its use in the treatment of the common cold in over 11,000 people. They found that for intakes of vitamin C greater than 200 milligrams, vitamin C reduced the duration and severity of common cold symptoms but not the number of colds someone gets in a year. However, in extreme physical stress as experienced by marathon runners and skiers, vitamin C reduced the common cold risk by half. Another group of scientists found that vitamin C (when individuals used 500 milligrams per day) reduced the frequency of the common cold but did not affect the duration or severity. One study performed during the peak of cold/flu season showed that 1,000 mg of vitamin C reduced the number of colds by 36 percent and the duration if one developed by 59 percent. The participants in this study stated that they had more energy.

This vitamin also may reduce levels of low-density lipoproteins (LDL, the so-called bad cholesterol), while increasing levels of high-density lipoproteins (HDL, or "good cholesterol"), as well as lowering high blood pressure and helping to prevent atherosclerosis. People with high blood pressure, high blood sugar, or both benefited from 500 mg of vitamin C over eight weeks. Compared to a group not getting vitamin C, those who did experienced a reduction in fasting blood sugar and two markers of inflammation (i.e., C-reactive protein and interleukin-6). Vitamin C seems to be a potent anti-inflammatory agent and is likely effective because it is an antioxidant. Essential in the formation of collagen, vitamin C protects against abnormal blood clotting and bruising, may reduce the risk of cataracts, and promotes the healing of wounds and burns. It may even boost your love life by causing more of the hormone oxytocin to be released.

Vitamin C has been useful in managing *Helicobacter pylori* (commonly known as *H. pylori*). *H. pylori* is a bacteria

blood pressure, an inability to digest fats, kidney and liver impairment, and stunted growth.

Research in the last decade indicates that choline plays an important role in cardiovascular health, as well as in reproduction and fetal development. One study showed a need for choline for both prevention and treatment of arteriosclerosis and the metabolism of homocysteine. This is such an important nutrient that in 1998 it was added to the list of essential compounds. People who have a high choline intake have the lowest levels of inflammation in the body, which reduces their risk of heart disease. Postmenopausal women may have a higher need for choline because dietary choline requires estrogen to become usable by the body and estrogen levels drop with age. Also, many women have a genetic variation that limits choline availability, so it's even more important to get adequate choline from the diet.

Sources

The following foods contain significant amounts of choline: broccoli, oat bran, egg yolks, lecithin (about 13 percent choline by weight), legumes, liver, meat, milk, nuts, shrimp, soybeans, and whole-grain cereals. If you are managing your cholesterol levels, using one egg yolk for every two egg whites will help you get enough choline.

Folate

Also known as folacin, folic acid, or pteroylglutamic acid (PGA), folate is considered a brain food, and is needed for energy production and the formation of red blood cells. It also strengthens immunity by aiding in the proper formation and functioning of white blood cells. Because it functions as a coenzyme in DNA and RNA synthesis, it is important for healthy cell division and replication. It is involved in protein metabolism and has been used in the prevention and treatment of folic acid anemia. This nutrient may also help depression and anxiety, and may be effective in the treatment of uterine cervical dysplasia. People with Alzheimer's disease who received supplemental folic acid (1.25 milligrams a day) for six months had better cognition compared to a group of similar patients who did not get the supplements. Folic acid may reduce inflammation, which is associated with Alzheimer's disease.

Folate may be the most important nutrient in regulating homocysteine levels. Homocysteine is an amino acid that is naturally formed in the body as the result of the breakdown of another amino acid, methionine. In recent years, high levels of homocysteine have been found to be associated with an increased risk of atherosclerosis (hardening of the arteries due to the accumulation of fatty plaques). Normally, homocysteine is converted to other, non-harmful amino acids in the body. In order for this conversion to take place as it should, the body needs an adequate supply of folate, as well as of vitamins B₆ and B₁₂. Homocysteine levels in red blood cells have been shown to have an inverse relationship to levels of these three important B vitamins—that is, the lower the levels of these vitamins, the higher the

level of homocysteine. Folic acid may help reduce the risk of stroke. People who are taking blood-pressure-lowering medications were randomized to folic acid (0.8 milligrams a day) or none. Those getting the blood pressure drug and folic acid had a significant decrease in the development of stroke (26 percent).

Folate is very important in pregnancy. It helps to regulate embryonic and fetal nerve cell formation, which is vital for normal development. Studies have shown that a daily intake of 400 micrograms of folate in early pregnancy may prevent the vast majority of neural tube defects, such as spina bifida and anencephaly. It may also help to prevent premature birth. To be effective, this regimen must begin *before* conception and continue for at least the first three months of pregnancy; if a woman waits until she knows she is pregnant, it may be too late, because critical events in fetal development occur during the first six weeks of pregnancy—before many women know that they have conceived. In the mid-1990s, the government required that enriched grain products be fortified with folic acid. This was an attempt to achieve an across-the-board reduction in neural-tube birth defects such as spina bifida. Since the program started, there has also been a decline in stroke-related deaths that appears to be related. Researchers attribute this decline to the reduction of serum homocysteine levels in the population as a whole. However, some researchers worry that the higher folic acid intake may mask B₁₂ deficiencies. If you are worried about low B₁₂ (see B₁₂, above), consult your health care practitioner before taking folic acid supplements.

Many experts still recommend that every woman of childbearing age take a folate supplement daily as a matter of course. Folate works best when combined with vitamin B₁₂ and vitamin C. Another option is to simply take a good-quality multivitamin; most have at least 400 micrograms of folic acid and these other nutrients.

A sore, red tongue is one sign of folate deficiency. Other possible signs include anemia, apathy, digestive disturbances, fatigue, graying hair, growth impairment, insomnia, labored breathing, memory problems, paranoia, weakness, and birth defects in one's offspring. Folate deficiency may be caused by inadequate consumption of fresh fruits and vegetables; consumption of only cooked or microwaved vegetables (cooking destroys folate); and malabsorption problems.

Sources

The following foods contain significant quantities of folate: asparagus, avocados, barley, beef, bran, brewer's yeast, brown rice, cheese, chicken, dates, green leafy vegetables, lamb, legumes, lentils, liver, milk, mushrooms, oranges, split peas, pork, root vegetables, salmon, tuna, wheat germ, whole grains, and whole wheat. Unlike most other nutrients, synthetic folic acid from a supplement is more bioavailable than folic acid from food. It is best to eat folate-rich foods and take a supplement, especially if you are a woman of childbearing age.

A vitamin B₁₂ deficiency can be caused by malabsorption, which is most common in older adults and in people with digestive disorders. Deficiency can cause abnormal gait, bone loss, chronic fatigue, constipation, depression, digestive disorders, dizziness, drowsiness, enlargement of the liver, eye disorders, hallucinations, headaches (including migraines), inflammation of the tongue, irritability, labored breathing, memory loss, moodiness, nervousness, neurological damage, palpitations, pernicious anemia, ringing in the ears, and spinal cord degeneration.

Researchers caution that all patients with unexplained anemia and/or neurological symptoms, as well as patients at risk of developing low B₁₂ levels like the elderly and those with intestinal disorders, should have blood levels measured. In addition, those with cognitive impairment may want to be tested for low B₁₂ levels. Long-term studies that looked for benefits of B₁₂ in older patients with peripheral and central nerve problems did not pan out. Widespread supplementation of B₁₂ is not warranted in older individuals who are experiencing neurological problems. Thirty-four percent of patients with COPD had B₁₂ deficiencies. Those that received supplements of B₁₂ experienced improvements in the ability to exercise longer and harder.

Strict vegetarians must remember that they require vitamin B₁₂ supplementation, as this vitamin is found almost exclusively in animal tissues. Although people who follow a strictly vegetarian diet may not see any signs of the deficiency for some time—the body can store up to five years' worth of vitamin B₁₂—signs eventually will develop. Those who have followed a vegetarian diet for a long time (more than five years) should have B₁₂ blood levels measured yearly.

Sources

The largest amounts of vitamin B₁₂ are found in meats, brewer's yeast, clams, eggs, herring, kidney, liver, mackerel, milk and dairy products, poultry, and seafood. Vitamin B₁₂ is not found in many vegetables; it is available only from sea vegetables, such as dulse, kelp, kombu, bladderwrack, and nori, and soybeans and soy products. It is believed that bacteria present in the large intestine synthesize most B₁₂. It is also present in the herbs alfalfa and hops.

Comments

Antigout medications, anticoagulant drugs, and potassium supplements may block the absorption of vitamin B₁₂ from the digestive tract. Taking vitamin B₁₂ in sublingual tablets, which are dissolved under the tongue rather than swallowed, can be a good option for those who have difficulty absorbing this vitamin. *Intrinsic factor* is a protein produced in the gastrointestinal tract that is necessary for absorption of vitamin B₁₂. People who lack intrinsic factor must use a sublingual form (or injections) for absorption. A blood test called the Schilling test can be used to determine the body's ability to absorb vitamin B₁₂.

At this time there are still some health food stores that do not stock the methylcobalamin form of vitamin B₁₂. It

is expected that as research results become more widely known, the methylcobalamin form will become easier to find in your local health food store or online under various brand names.

Biotin

Biotin aids in cell growth; in fatty acid production; in the metabolism of carbohydrates, fats, and proteins; and in the utilization of the other B-complex vitamins. Sufficient quantities are needed for healthy hair and skin. People with brittle nails who received a topical lacquer treatment and biotin experienced improvement in how their nails looked. Most (80 percent) had more than a 50 percent improvement on a validated questionnaire about nail appearance. One hundred milligrams of biotin daily may prevent hair loss in some men. Biotin also promotes healthy sweat glands, nerve tissue, and bone marrow. In addition, it helps to relieve muscle pain.

In infants, a condition called *seborrheic dermatitis*, or cradle cap, which is characterized by a dry, scaly scalp, may occur as a result of biotin deficiency. In adults, deficiency of this B vitamin is rare because it can be produced in the intestines from foods such as those mentioned below. However, if a deficiency does occur, it can cause anemia, depression, hair loss, high blood sugar, inflammation or pallor of the skin and mucous membranes, insomnia, loss of appetite, muscular pain, nausea, and soreness of the tongue. Biotin is showing promise for patients with progressive multiple sclerosis. Taking large amounts (200 mg, three times daily) resulted in such improvements as being less disabled and having the disease progress more slowly.

Sources

Biotin is found in avocados, brewer's yeast, cooked egg yolks, liver, meat, milk, poultry, salmon, saltwater fish, soybeans, and whole grains.

Comments

Raw egg whites contain a protein called avidin, which combines with biotin in the intestinal tract and depletes the body of this needed nutrient. Fats and oils that have been subjected to heat or exposed to the air for any length of time inhibit biotin absorption. Antibiotics, sulfa drugs, and saccharin also threaten the availability of biotin.

Choline

Choline is needed for the proper transmission of nerve impulses from the brain through the central nervous system, as well as for gallbladder regulation, liver function, and lecithin formation. It aids in hormone production and minimizes excess fat in the liver because it aids in fat and cholesterol metabolism. Without choline, brain function and memory are impaired. Choline is beneficial for disorders of the nervous system such as Parkinson's disease and tardive dyskinesia. A deficiency may result in fatty buildup in the liver, as well as in cardiac symptoms, gastric ulcers, high

VITAMINS

blood pressure, and impairment, and

Research in the an important role reproduction and need for choline teriosclerosis and is such an important the list of essential choline intake h the body, which menopausal women because dietary able by the body many women have availability, so it choline from the

Sources

The following foods: broccoli, oat bran, choline by weight soybeans, and your cholesterol egg whites will

Folate

Also known as (PGA), folate is energy production also strengthens and function as a coenzyme for healthy in protein metabolism and treatment of help depression treatment of uterine disease women's disease a day compared to a group supplements. Folate associated with

Folate may be homocysteine level is naturally found down of another high levels of h ated with an increase of the arteries Normally, homocysteine acids in the place as it should late, as well as c in red blood cell lation ship to level that is the lower

uretic, reducing the symptoms of premenstrual syndrome, and it may be useful in preventing calcium oxalate kidney stones as well. It is helpful in the treatment of allergies, arthritis, and asthma.

A deficiency of vitamin B₆ can result in anemia, convulsions, headaches, nausea, flaky skin, a sore tongue, and vomiting. Other possible signs of deficiency include acne, anorexia, arthritis, conjunctivitis, cracks or sores on the mouth and lips, depression, dizziness, fatigue, hyperirritability, impaired wound healing, inflammation of the mouth and gums, learning difficulties, impaired memory or memory loss, hair loss, hearing problems, numbness, oily facial skin, stunted growth, and tingling sensations. Carpal tunnel syndrome has been linked to a deficiency of vitamin B₆ as well.

Sources

All foods contain some vitamin B₆; however, the following foods have the highest amounts: brewer's yeast, carrots, chicken, eggs, fish, meat, peas, spinach, sunflower seeds, walnuts, and wheat germ. Other sources include avocado, bananas, beans, blackstrap molasses, broccoli, brown rice and other whole grains, cabbage, cantaloupe, corn, dulse (a red seaweed), plantains, potatoes, rice bran, soybeans, and tempeh. Herbs that contain vitamin B₆ include alfalfa, catnip, and oat straw.

Comments

Antidepressants, estrogen therapy, and oral contraceptives may increase the need for vitamin B₆. Diuretics and cortisone drugs block the absorption of this vitamin by the body.

Prolonged use of high doses of vitamin B₆ (over 1,000 milligrams per day) can be toxic, and may result in nerve damage and loss of coordination.

Vitamin B₁₂ (Methylcobalamin)

Vitamin B₁₂ is the most chemically complex of all the vitamins and is the general name for a group of essential biological compounds known as cobalamins. The cobalamins are similar to hemoglobin in the blood except that instead of iron they contain cobalt. Vitamin B₁₂ comes in several forms. Not all forms are equally effective. The most effective form is methylcobalamin. However, the most common form is cyanocobalamin, because it is easier to manufacture and is therefore less expensive.

Unfortunately, the very common and inexpensive cyanocobalamin form is difficult for the body to absorb, and the small amount that is absorbed usually fails to find its way into the cells, where it can perform its intended tasks. The liver does, however, convert a small amount of cyanocobalamin into methylcobalamin, but much larger amounts than can be converted are needed to carry out the normal functions of vitamin B₁₂. As a result, many people who take large doses of cyanocobalamin continue to be deficient in the vitamin. They often find themselves resorting to vitamin B₁₂ injections, which are available from a doctor by prescription only. Vitamin B₁₂ deficiency caused

by malabsorption is most common in elderly people. A simple alternative is to take the methylcobalamin form in the first place, either swallowed in tablet form or sublingually. Those with severe digestive disorders may have no choice but to resort to vitamin B₁₂ injections. Injections usually are administered every two to three months.

Methylcobalamin is active in the growth and protection of the nervous system. Larger quantities are especially necessary to protect against neurological deterioration as we age. One Danish study found that daily supplementation with 6 micrograms per day (the DV is 2.4 micrograms) appeared to be sufficient to correct deficiencies in women aged forty-one to seventy-five years.

Vitamin B₁₂, in the methylcobalamin form, may help prevent Parkinson's disease and slow the progression in those who already have the disease by protecting against neural toxicity caused by excess L-dopa, a probable cause of the disease. The vitamin has been shown to reverse the symptoms of such rare neurological diseases as Bell's palsy (see page 739), and shows promise in the treatment of multiple sclerosis and other neurological diseases. Very few substances are known to have any impact on regenerating damaged nerves in humans. However, a 1994 study in the *Journal of Neurological Science* suggested that the methylcobalamin form of vitamin B₁₂ could increase the synthesis of certain proteins that help regenerate nerves. The study showed that very high doses of methylcobalamin produced nerve regeneration in rats. No substantive human studies on nerve regeneration are known to date, but as new research is reported, it will be included in future editions of this book.

Methylcobalamin is essential in converting homocysteine into methionine, which is used to build protein. As such, it plays an important role in protein synthesis necessary for cardiovascular function. It has been found that high levels of homocysteine that have gone unconverted may be toxic to the lining of the blood vessels and may increase clotting factors, which can result in the buildup of plaque and eventually lead to heart disease and stroke. As such, vitamin B₁₂ plays an important role in protein synthesis necessary for cardiovascular function.

Vitamin B₁₂ is needed to prevent anemia; it aids folic acid in regulating the formation of red blood cells and helps in the utilization of iron. This vitamin is also required for proper digestion, absorption of foods, and the metabolism of carbohydrates and fats. It aids in cell formation and cellular longevity. In addition, vitamin B₁₂ prevents nerve damage, maintains fertility, and promotes normal growth and development by maintaining the fatty sheaths that cover and protect nerve endings. A study reported in the *American Journal of Obstetrics and Gynecology* in 2004 found that women who gave birth to children with spina bifida had vitamin B₁₂ levels that were 21 percent lower than those of mothers who had had healthy children. Vitamin B₁₂ is also linked to the production of acetylcholine, a neurotransmitter that assists memory and learning. Vitamin B₁₂ supplementation has been shown to enhance sleep patterns, allowing for more restful and refreshing sleep.

Comments

Factors that increase the need for riboflavin include the use of oral contraceptives and strenuous exercise. This B vitamin is easily destroyed by light, antibiotics, and the consumption of alcohol. Taking too much riboflavin (over 50 milligrams daily) over a long period of time may lead to cataracts and retinal diseases. Taking high doses also may turn urine a deep yellow.

Vitamin B₃ (Niacin, Nicotinic Acid, Niacinamide)

Vitamin B₃ is needed for proper circulation and healthy skin. It aids in the functioning of the nervous system; in the metabolism of carbohydrates, fats, and proteins; and in the production of hydrochloric acid for the digestive system. It is involved in the normal secretion of bile and stomach fluids, and in the synthesis of sex hormones. Niacin (nicotinic acid) lowers cholesterol and improves circulation. It is helpful for schizophrenia and other mental illnesses and also enhances memory.

Pellagra is a disease caused by niacin deficiency. Other symptoms of niacin deficiency include canker sores, dementia, depression, diarrhea, dizziness, fatigue, halitosis, headaches, indigestion, insomnia, limb pains, loss of appetite, low blood sugar, muscular weakness, skin eruptions, and inflammation.

Sources

Niacin and niacinamide are found in beef liver, brewer's yeast, broccoli, carrots, cheese, corn flour, dandelion greens, dates, eggs, fish, milk, nuts, peanuts, pork, potatoes, rabbit, tomatoes, wheat germ, and whole wheat products. Herbs that contain niacin include alfalfa, burdock root, catnip, cayenne, chamomile, chickweed, eyebright, fennel seed, hops, licorice, mullein, nettle, oat straw, parsley, peppermint, raspberry leaf, red clover, rose hips, slippery elm, and yellow dock. A cup of coffee provides about 3 milligrams of niacin.

Comments

A flush, usually harmless, may occur after you take a niacin supplement; you might develop a red rash on your skin and a tingling sensation may be experienced as well. Usually, these symptoms last only a few minutes.

There are two forms of this vitamin: niacin (or nicotinic acid) and niacinamide. In the form of niacinamide, it does not cause flushing. However, niacinamide does not have all the same properties of niacin. Specifically, it is not effective for lowering blood cholesterol.

Taking high doses of special extended-release niacin is sometimes used for cholesterol control. The intent is to lower levels of low-density lipoproteins (LDL, or "bad," cholesterol), raise levels of high-density lipoproteins (HDL, or "good," cholesterol), and reduce triglyceride levels. This type of niacin is *not* dietary niacin. A product called Niaspan, produced by Abbott Laboratories, is an extended-release type of niacin approved for cholesterol control.

Cautions

Dietary niacin should *not* be substituted for Niaspan. Taking high doses of dietary niacin (more than 500 milligrams daily) can damage the liver. People who are pregnant or who suffer from diabetes, glaucoma, gout, liver disease, or peptic ulcers should use niacin supplements with caution. Niacin can elevate blood sugar levels. People who are diabetics should avoid large amounts of niacin. In one study, those who received the vitamin (100 milligrams a day) experienced more panic symptoms and seemed more fearful compared to those who didn't get niacin.

Vitamin B₅ (Pantothenic Acid)

Known as the antistress vitamin, pantothenic acid plays a role in the production of the adrenal hormones and the formation of antibodies, aids in vitamin utilization, and helps to convert fats, carbohydrates, and proteins into energy.

Pantothenic acid is required by all cells in the body and is concentrated in the organs. It is also involved in the production of neurotransmitters. This vitamin is an essential element of coenzyme A, a vital body chemical involved in many necessary metabolic functions. Pantothenic acid is also a stamina enhancer and prevents certain forms of anemia. It is needed for normal functioning of the gastrointestinal tract and may be helpful in treating depression and anxiety. A deficiency of pantothenic acid may cause fatigue, headache, nausea, and tingling in the hands. Pantothenic acid is also needed for proper functioning of the adrenal glands.

Sources

The following foods contain pantothenic acid: avocados, beef, brewer's yeast, broccoli, eggs, fresh vegetables, kidney, legumes, liver, lobster, milk, mushrooms, nuts, pork, royal jelly, saltwater fish, sweet potatoes, torula yeast, whole rye flour, and whole wheat.

Vitamin B₆ (Pyridoxine)

Pyridoxine is involved in more bodily functions than almost any other single nutrient. It affects both physical and mental health. It is beneficial if you suffer from water retention, and is necessary for the production of hydrochloric acid and the absorption of fats and protein. It also aids in maintaining sodium and potassium balance and promotes red blood cell formation.

Pyridoxine is required by the nervous system and is needed for normal brain function and for the synthesis of the nucleic acids RNA and DNA, which contain the genetic instructions for the reproduction of all cells and for normal cellular growth. It activates many enzymes and aids in the absorption of vitamin B₁₂, in immune system function, and in antibody production.

Vitamin B₆ plays a role in cancer immunity and aids in the prevention of arteriosclerosis. It inhibits the formation of a toxic chemical called homocysteine, which attacks the heart muscle and allows the deposition of cholesterol around the heart muscle. Pyridoxine acts as a mild di-

uretic, red, and it may stones as arthritis, a

A deficiency of vitamin B₆ can cause convulsions, and vomiting, acne, anorexia, the mouth, irritability, mouth and or memory, oily facial, Carpal tunnel, of vitamin

Sources

All foods contain vitamin B₆. Foods have chicken, eggs, walnuts, and bananas, but and other (a red sea, and temper, catnip, and

Comments

Antidepressants may increase the risk of side effects from some drugs.

Prolonged use of high milligram doses may damage the

Vitamin B₁₂

Vitamin B₁₂ is a water-soluble vitamin. It is essential for the normal function of the nervous system and for the production of red blood cells. It is also necessary for the production of DNA and RNA, which are the building blocks of life. It is also necessary for the production of energy. It is found in animal products, but not in plant products. It is also found in some fortified foods.

Unfortunatly, many people are deficient in vitamin B₁₂. This is because the body cannot produce it on its own. It must be obtained from food or supplements. People who are vegetarians or who have a condition called pernicious anemia are at risk of being deficient in vitamin B₁₂. It is also possible to be deficient in vitamin B₁₂ if you are taking certain medications or if you have a condition called atrophic gastritis.

It is important to get enough vitamin B₁₂ because a deficiency can lead to serious health problems, including anemia, nerve damage, and cognitive impairment.

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include constipation, edema, enlarged liver, fatigue, forgetfulness, gastrointestinal disturbances, heart changes, irritability, labored breathing, loss of appetite, muscle atrophy, nervousness, numbness of the hands and feet, pain and sensitivity, poor coordination, tingling sensations, weak and sore muscles, general weakness, and severe weight loss.

Benfotiamine is a fat-soluble form of the water-soluble vitamin B₁. Its use is reserved for cases such as alcoholic peripheral neuropathy, a disorder involving decreased nerve functioning caused by damage from excessive drinking of alcohol. It is found naturally in small quantities in roasted crushed garlic, as well as in onions, shallots, and leeks. This variant of the vitamin lasts longer in the body, yielding potentially therapeutic benefits that regular vitamin B₁ cannot achieve. Benfotiamine may be more effective than thiamine in controlling damage from diabetes because it is a better activator of the enzyme transketolase. This enzyme assists in keeping glucose-derived compounds out of healthy vascular (blood vessel) and nerve cells. The normal supplemental dose is 150 to 600 milligrams per day, taken under the guidance of a doctor or other qualified health care practitioner.

Sources

The richest food sources of thiamine include brown rice, egg yolks, fish, legumes, liver, peanuts, peas, pork, poultry, rice bran, sunflower seeds, wheat germ, and whole grains. Other sources include asparagus, brewer's yeast, broccoli, Brussels sprouts, dulse, kelp, most nuts, oatmeal, plums, dried prunes, raisins, spirulina, and watercress. Herbs that contain thiamine include alfalfa, bladderwrack, burdock root, catnip, cayenne, chamomile, chickweed, eyebright, fennel seed, fenugreek, hops, nettle, oat straw, parsley, peppermint, raspberry leaf, red clover, rose hips, sage, yarrow, and yellow dock.

Comments

Antibiotics, phenytoin (Dilantin, a drug used to prevent seizures), sulfa drugs, and oral contraceptives, as well as heavy alcohol or caffeine consumption, may decrease thiamine levels in the body. A high-carbohydrate diet increases the need for thiamine. Alcoholics are among those most often deficient in thiamine because the alcohol inhibits its storage. This is sometimes manifested as a disorder known as Wernicke-Korsakoff syndrome, which is characterized by memory problems, abnormal movements, confusion, drowsiness, and other symptoms. Thiamine has been helpful in treating young patients (average age, thirty-five years) with major depressive disorders who are taking antidepressants. In comparison to a placebo, adjuvant thiamine alleviated symptoms of depression faster. Importantly, improvements were observed within six weeks of initiation of treatment. Thiamine may also support heart function. Patients with chronic heart failure who took a large amount of thiamine (300 mg/day for 30 days) and were taking diuretics experienced an increased ability of

the heart to pump blood. This study suggests that thiamine supplementation along with diuretic drugs has beneficial effects on cardiac function in patients with symptomatic chronic heart failure.

Vitamin B₂ (Riboflavin)

Riboflavin is necessary for red blood cell formation, antibody production, cell respiration, and growth. It alleviates eye fatigue and is important in the prevention and treatment of cataracts. It aids in the metabolism of carbohydrates, fats, and proteins. Together with vitamin A, it maintains and improves the mucous membranes in the digestive tract. Riboflavin also facilitates the use of oxygen by the tissues of the skin, nails, and hair; eliminates dandruff; and helps the absorption of iron and vitamin B₆ (pyridoxine). People over the age of sixty years are more likely to have a deficiency of riboflavin, which could lead to vitamin B₆ not functioning properly.

Consumption of adequate amounts of riboflavin is important during pregnancy, because a lack of this vitamin can damage a developing fetus even if a woman shows no signs of deficiency. Riboflavin is needed for the metabolism of the amino acid tryptophan, which is converted into niacin in the body. Carpal tunnel syndrome may benefit from a treatment program that includes riboflavin and vitamin B₆. Riboflavin may help patients who experience frequent migraine headaches. Migraine sufferers who took a proprietary blend of riboflavin, Coenzyme Q₁₀, and magnesium had fewer migraine days per month over three months (declined from 6.2 days during the baseline period to 4.4 days at the end of the treatment), and those that occurred were less severe.

Deficiency symptoms include cracks and sores at the corners of the mouth, eye disorders, inflammation of the mouth and tongue, and skin lesions, a group of symptoms collectively referred to as *ariboflavinosis*. Other possible deficiency symptoms include dermatitis, dizziness, hair loss, insomnia, light sensitivity, poor digestion, retarded growth, and slowed mental response. A low intake may impair mental and physical performance. Nearly 300 Chinese students were randomly assigned to consume a riboflavin-enriched milk or regular milk for six months. Those who got the enriched milk performed better at school, were better at sports, and overall were more confident.

Sources

High levels of vitamin B₂ are found in the following foods: cheese, egg yolks, fish, legumes, meat, milk, poultry, spinach, whole grains, and yogurt. Other sources include asparagus, avocados, broccoli, Brussels sprouts, currants, dandelion greens, dulse, kelp, leafy green vegetables, mushrooms, molasses, nuts, and watercress. Herbs that contain vitamin B₂ include alfalfa, bladderwrack, burdock root, catnip, cayenne, chamomile, chickweed, eyebright, fennel seed, fenugreek, ginseng, hops, mullein, nettle, oat straw, parsley, peppermint, raspberry leaves, red clover, rose hips, sage, and yellow dock.

High lutein consumption has also been reported to decrease the incidence of prostate cancer.

Science has not yet discovered all of the carotenoids, although one source documents six hundred different carotenoids identified so far. Combinations of carotenoids have been shown to be more beneficial than individual carotenoids taken alone.

Taking large amounts of vitamin A, more than 30,000 mcg (100,000 international units) daily, over long periods can be toxic to the body, mainly to the liver. Toxic levels of vitamin A are associated with abdominal pain, amenorrhea (cessation of menstruation), enlargement of the liver and/or spleen, gastrointestinal disturbances, hair loss, itching, joint pain, nausea and vomiting, water on the brain, elevated liver enzymes, and small cracks and scales on the lips and at the corners of the mouth. Excessive intake of vitamin A during pregnancy has been linked to birth defects, including cleft palate and heart defects. It is better to take beta-carotene during pregnancy. If you have a particular disorder that calls for taking high doses of vitamin A, use an emulsified form, which puts less stress on the liver.

No overdose can occur with beta-carotene, although if you take too much, your skin may turn slightly yellow-orange in color. Beta-carotene does not have the same effect as vitamin A in the body and is not harmful in larger amounts unless your liver cannot convert beta-carotene into vitamin A. There is mixed evidence (mostly from studies done in Europe) as to whether too much vitamin A may increase the risk of osteoporosis. In the United States, women usually don't have a problem with getting too much vitamin A because manufacturers mix beta-carotene with vitamin A. However, women who are worried about osteoporosis should consult a health care provider before taking vitamin A. It is important to take only *natural* beta-carotene or a natural carotenoid complex. Betatene is the trade name for a type of carotenoid complex extracted from sea algae. Different manufacturers use it as an ingredient in various products.

Sources

Vitamin A can be obtained from animal livers, fish liver oils, and green and yellow fruits and vegetables. Foods that contain significant amounts include apricots, asparagus, beet greens, broccoli, cantaloupe, carrots, collards, dandelion greens, dulse (a red seaweed), fish liver and fish liver oil, garlic, kale, mustard greens, papayas, peaches, pumpkin, red peppers, spinach, spirulina, sweet potatoes, Swiss chard, turnip greens, watercress, and yellow squash. It is also present in the following herbs: alfalfa, borage leaves, burdock root, cayenne (capsicum), chickweed, eyebright, fennel seed, hops, kelp, lemongrass, mullein, nettle, oat straw, paprika, parsley, peppermint, plantain, raspberry leaf, red clover, rose hips, sage, uva ursi, violet leaves, watercress, and yellow dock. Animal sources of vitamin A are up to six times as strong as vegetable sources, but you should exercise caution if you choose to eat organ meats. A plant-based diet better promotes overall health.

UNDERSTANDING THE ELEMENTS OF HEALTH

Comments

Antibiotics, laxatives, and some cholesterol-lowering drugs interfere with the absorption of vitamin A.

Cautions

If you have liver disease, do not take a daily dose of over 3,000 mcg (10,000 international units) of vitamin A in pill form, or any amount of cod-liver oil. If you are pregnant, do not take more than 3,000 mcg (10,000 international units) of vitamin A daily because of reported problems in fetal development. Children should not take excess vitamin A unless prescribed by a physician. For most people, beta-carotene is the best source of vitamin A because it is converted by the liver into only the amount of vitamin A that the body actually needs. However, if you have diabetes or hypothyroidism, there is a good possibility your body cannot convert beta-carotene into vitamin A. Consuming large amounts of beta-carotene may therefore place unnecessary stress on your liver.

Vitamin B Complex

The B vitamins help to maintain the health of the nerves, skin, eyes, hair, liver, and mouth, as well as healthy muscle tone in the gastrointestinal tract and proper brain function.

B-complex vitamins act as coenzymes, helping enzymes to react chemically with other substances, and are involved in energy production. They may be useful for alleviating depression or anxiety as well. Adequate intake of the B vitamins is very important for elderly people because these nutrients are not as well absorbed as we age. There have even been cases of people diagnosed with Alzheimer's disease whose problems were later found to be due to a deficiency of vitamin B₁₂ plus the B-complex vitamins. The B vitamins should always be taken together, but up to two to three times more of one B vitamin than another can be taken for a period of time if needed for a particular disorder. There are spray and sublingual forms that are absorbed more easily, which are good choices for older adults and those with absorption problems.

Because the B vitamins work together, a deficiency in one often indicates a deficiency in another. Although the B vitamins are a team, they will be discussed individually.

Vitamin B₁ (Thiamine)

Thiamine (thiamine hydrochloride) enhances circulation and assists in blood formation and carbohydrate metabolism, and in the production of hydrochloric acid, which is important for proper digestion. Thiamine also optimizes cognitive activity and brain function. It has a positive effect on energy, growth, normal appetite, and learning capacity, and is needed for proper muscle tone of the intestines, stomach, and heart. Thiamine also acts as an antioxidant, protecting the body from the degenerative effects of aging, alcohol consumption, and smoking.

Beriberi, a nervous system disease that is rare in developed nations, is caused by a deficiency of thiamine. Other symptoms that can result from thiamine deficiency

VITAMIN

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Benfo vitamin i ripheral function alcohol crushed This vari ing poten cannot a thiamine is a bette zyme assi healthy v mal suppli taken und health car

Sources

The riches egg yolks, rice bran, Other sou Brussels spr dried prun contain th root, catni fennel seed permint, ra and yellow

Comment

Antibiotics, seizures), s heavy alcoh amine level es the need often defic storage. Thi as Wernicke by memory drowsiness, helpful in t five years) w in antidepress thiamine alle tantly, impro initiation of f function. Pat large amount we taking c

tongue), lozenge, nano particles, and liquid forms. They can also be administered by injection.

In most cases, it is a matter of personal preference as to how you take them; however, due to slight variations in how rapidly the supplements are absorbed and assimilated into the body, we will sometimes recommend one form over another. These recommendations are given throughout the book.

Vitamin supplements are usually available as isolated vitamins or in combination with other nutrients. It is important to select your vitamins based upon what you really need. A program designed for health maintenance would be different from one designed to overcome a specific disorder. Some 50 percent of Americans are now taking supplements on a regular basis.

If you find one supplement that meets your needs, remember to take it daily. If it does not contain a large enough quantity of what you want, you may consider taking more than one. Just make sure that you are aware of the increased dosage of the other nutrients it may contain. If there is no single supplement that provides you with what you are looking for, consider taking a combination of different supplements. This book lists each supplement separately, so you will know what each does and the amount needed. But you may find a supplement that contains several needed nutrients in one tablet or capsule. In fact, a good multivitamin (and multimineral) should be a part of everyone's diet after he or she reaches a certain age, with additional supplements as necessary.

Because the potency of most vitamins may be decreased by sunlight, make sure that the container holding your vitamins is dark enough to shield its contents properly. Some people may be sensitive to plastic and may need to purchase vitamins in glass containers. Vitamin supplements should be kept in a cool, dark place.

All vitamin supplements work best when taken in combination with food. Unless specified otherwise, oil-soluble vitamins should be taken before meals, and water-soluble ones should be taken after meals. (This applies when you are taking individual supplements only. Multivitamins have both water-soluble and fat-soluble elements.) If you are concerned about getting the full potency from your supplements, you may want to try using raw-food-created vitamins made from a single-cell yeast, *Saccharomyces cerevisiae*. This yeast creates vitamins and minerals that are not isolated or synthesized, but that come from nutrient-dense whole foods. One of the best sources of raw-food-created vitamins is Garden of Life.

VITAMINS FROM A TO Z

Vitamin A and the Carotenoids

Vitamin A prevents night blindness and other eye problems, as well as some skin disorders, such as acne. It enhances immunity, may help to heal gastrointestinal ulcers, and is needed for the maintenance and repair of epithelial tissue, of which the skin and mucous membranes are composed.

It is important in the formation of bones and teeth, aids in fat storage, and protects against colds, flu, and infections of the kidneys, bladder, lungs, and mucous membranes. Vitamin A acts as an antioxidant, helping to protect the cells against cancer and other diseases (see ANTIOXIDANTS in Part One) and is necessary for new cell growth. It guards against heart disease and stroke and lowers cholesterol levels. People receiving radiation treatment for cervical cancer, prostate cancer, or colorectal cancer have benefited from taking oral vitamin A. Radiation-induced anal ulcers can be a problem with such treatment programs, and a vitamin A megadose (30,000 mcg; 100,000 international units daily) significantly reduced symptoms in 88 percent of people undergoing such regimens. Girls with frequent urinary tract infections benefited from vitamin A by having fewer days with a fever, less frequent urination, and a faster return to appetite compared to a group who did not get vitamin A. This important vitamin also slows the aging process. The body cannot utilize protein without vitamin A. Vitamin A is a well-known wrinkle eliminator. Applied topically in the form of tretinoin (the active ingredient in Retin-A and Renova), vitamin A reduces fine lines in the skin and helps to fade age spots.

A deficiency of vitamin A can cause dry hair and/or skin, dryness of the conjunctiva and cornea, poor growth, and/or night blindness. Other possible results of vitamin A deficiency include abscesses in the ears; insomnia; fatigue; reproductive difficulties; sinusitis, pneumonia, and frequent colds and other respiratory infections; skin disorders, including acne; and weight loss.

The *carotenoids* are a class of compounds related to vitamin A. In some cases, they can act as precursors of vitamin A; some act as antioxidants or have other important functions.

The best-known subclass of the carotenoids is the carotenes, of which beta-carotene is the most widely known. Also included in this group are alpha-carotene, gamma-carotene, and lycopene. When food or supplements containing beta-carotene are consumed, the beta-carotene is converted into vitamin A in the liver. According to some reports, beta-carotene appears to aid in cancer prevention by scavenging, or neutralizing, free radicals. One study reported in the *Journal of the National Cancer Institute*, published in May 2003, found that people who took beta-carotene supplements and who smoked and drank alcohol doubled their risk of precancerous colorectal tumors, while for those who also took the supplements but who didn't smoke or drink, there was a 44 percent decrease in their risk. Other types of carotenoids that have been identified are the xanthophylls (including beta-cryptoxanthin, canthaxanthin, lutein, and zeaxanthin); the limonoids (including limonene); and the phytosterols (including perillyl alcohol). Evidence suggests that greater consumption of lutein reduces the risk of cataracts and age-related macular degeneration (AMD), and that taking lutein supplements can slow the progress of these disorders, although it does not appear to reverse them if they are already established.

Aspirin can irritate the gastrointestinal tract and may cause gastrointestinal bleeding. Aspirin can also interfere with the absorption of B vitamins and vitamin C. If you are taking aspirin daily for cardiovascular health, it is better to take baby aspirin—studies have shown that it is less irritating to the gastrointestinal tract, and it works just as well as ordinary aspirin. Baby aspirin usually has 80 milligrams of aspirin, but check with your health care provider before using aspirin in this way.

BASIC GUIDELINES FOR SELECTING AND PREPARING FOODS

Clearly, a healthy diet must provide a proper balance of the four essential nutrients, as well as a rich supply of vitamins, minerals, and other micronutrients. The EAT-Lancet diet offers a sound way to get a nutrient-rich diet. This diet optimizes health while preserving the planet. However, it is not enough simply to purchase foods that are high in complex carbohydrates with low-glycemic indexes, fiber, and complementary proteins, and low in saturated fats. Food also must be free of harmful additives, and it must be prepared in a way that preserves its nutrients and avoids the production of harmful substances.

When nutritionists talk about diet, they are referring to live whole foods—unprocessed food with nothing added or taken away. Whole foods are more healthful because they usually contain no potentially harmful ingredients. In addition, plant foods are full of hundreds of phytochemicals that can help prevent disease and keep the body healthy. These are our frontline defenders against cancer and free radicals (see Phytochemicals on page 15). Foods known to supply important phytochemicals include soybeans and soy products, broccoli, citrus peels, flax, garlic, green tea, grapes, and tomatoes. In order to optimize your phytochemical intake, you need to consume a biodiverse diet. To achieve biodiversity in your diet, simply eating a lot of fruits and vegetables is not enough. A biodiverse diet includes not only consuming at least 8 to 10 servings ($\frac{1}{2}$ cup per serving) per day, but also making sure there is as much diversity within food groups as possible.

Limit Intake or Avoid Foods That Contain Additives and Artificial Ingredients

Additives are placed in foods for a number of reasons: to lengthen shelf life; to make a food more appealing by enhancing color, texture, or taste; to facilitate food preparation; or to otherwise make the product more marketable.

Certain additives, like sugar, are derived from natural sources. Other additives, like aspartame (in NutraSweet and Equal), are made synthetically. Sweeteners derived from natural sources include sucralose, the compound used in Splenda. Sucralose is synthesized from sucrose (sugar) and appears to be inert metabolically, which would make it ideal for people with diabetes. However, sucralose might be stored in the body simply because this synthetic mole-

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cule is never found in nature and the body is not equipped to metabolize it. We would advise limiting the use of this additive/artificial sweetener. Although many additives are used in very small amounts, it has been estimated that the average American consumes about 5 pounds of additives per year. If you include sugar—the food processing industry's most used additive—the number jumps to 135 pounds a year. Anyone whose diet is high in processed products clearly consumes a significant amount of additives and artificial ingredients.

At their best, additives and artificial ingredients simply add little or no nutritional value to a food product. At their worst, some additives could pose a threat to your health. The history of additive use includes a number of products that were once deemed safe but later were banned or allowed only if accompanied by warnings. The artificial sweeteners cyclamate and saccharin are just two examples of such products. Other additives, like monosodium glutamate (MSG) and aspartame, are used without warnings per se, but packages of food that contain them are now marked in the United States with sometimes cryptic statements, such as PHENYLKETONURICS: CONTAINS PHENYLALANINE, which appears on packets of Equal, NutraSweet, and other products containing aspartame. These products may cause problems for some sensitive people. The warning is there to protect children born with PKU (phenylketonuria). This condition is identified at birth so those who have it know they have it. The long-term effects of most sugar-substitute additives, including sucralose, are unknown. A safer sugar substitute is an extract made from the herb *Stevia rebaudiana*, which is available in health food stores. Stevia is derived from the leaf of a plant and is commercially available. It is a natural sweetener that does not affect blood sugar levels and yields a pleasant sweet taste. In 2009, the FDA granted stevia GRAS (Generally Recognized as Safe) status.

Increase Your Consumption of Raw Produce

The most healthful fruits and vegetables are those that have been grown organically—without the use of insecticides, herbicides, artificial fertilizers, or growth-stimulating chemicals. Organic produce can be found in select health food stores, as well as in some supermarkets and greenmarkets and through food co-ops.

When choosing your produce, look for fruits and vegetables that are at the peak of ripeness. These contain more vitamins and enzymes than do foods that are underripe or overripe, or that have been stored for any length of time. The longer a food is kept in storage, the more nutrients it loses.

Once you get your organic produce home, running water and a vegetable brush are probably all that will be needed to get it ready for the table. If the produce is not organic, however, you will want to wash it more thoroughly to rid it of any chemical residues. Use a soft vegetable brush to scrub the foods, and then let them soak in water for ten minutes.

You can also clean produce with nontoxic rinsing preparations, which are available in reputable health food

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stores. If you cannot be as healthy as possible,

Most fatigue, as a result of inadequate nutrition, but eat the bioflavonoids.

Although before eating, if possible, sensitive to process.

For many fruits, vegetables, and high It was discovered that foods are and enzymes protect the body. Others have contain phytochemicals in the

Phytochemicals plants that natural di protect the that cancer seem to lead to cancer.

For instance, molecule invades a broccoli, and that which any harm.

Other people er ways. For cancer-ca place. Also been shown cluding Al tumors by to nourish as Brussels activity and pinins, found may prevent and chloro chemical un protective s

Synergy and Deficiency

Data compiled by the U.S. Department of Agriculture indicate that at least 40 percent of the people in this country routinely consume a diet containing only 60 percent of the Recommended Daily Allowance (RDA) of each of ten selected nutrients. This means that close to half of the population (and very likely more) suffer from a deficiency of at least one important nutrient. Specially, 40 percent of men and 29 percent of women have vitamin deficiencies, and 54 percent of men and 44 percent of women have mineral deficiencies.

A poll of 37,000 Americans conducted by Food Technology found that half of them were deficient in vitamin B₆ (pyridoxine), 42 percent did not consume sufficient amounts of calcium, 39 percent had an insufficient iron intake, and 25 to 39 percent did not obtain enough vitamin C. Ames found that 90 percent of people don't get enough folate, vitamin D, and vitamin E. In children, more than 80 percent are deficient in vitamins A, D, and E. Based on the most recent information from 2015 to 2020, the nutrients that are most underconsumed are vitamins A, C, D, E, choline, calcium, magnesium, iron, potassium, and fiber. Of this group, not getting enough of some (vitamin D, calcium, potassium, and fiber) leads to adverse health outcomes. Additional research has shown that a vitamin deficiency may not affect the whole body, but only specific cells. For example, those who smoke may suffer from a vitamin C deficiency, but only in the lung area.

Whenever you seek to correct a vitamin or mineral deficiency, you must recognize that nutrients work synergistically. This means that there is a cooperative action between certain vitamins and minerals, which work as catalysts, promoting the absorption and assimilation of other vitamins and minerals. Correcting a deficiency in one vitamin or mineral requires the addition of others, not simply replacement of the one in which you are deficient. This is why taking a single vitamin or mineral may be ineffective or even dangerous, and why a balanced vitamin and mineral preparation should always be taken in addition to any single supplements. The following table indicates which vitamins and minerals are necessary to correct certain deficiencies. The best way to avoid interfering with the natural synergies among nutrients is to take supplements with meals, unless otherwise instructed. Food stimulates the natural digestive processes and contains natural nutrients to foster the digestion and absorption of nutrients from food and supplements.

VITAMINS	SUPPLEMENTS NEEDED FOR ASSIMILATION
Vitamin A	Choline, essential fatty acids, zinc, vitamins C, D, and E.
Vitamin B complex	Calcium, vitamins C and E.
Vitamin B ₁ (thiamine)	Manganese, vitamin B complex, vitamins C and E.
Vitamin B ₂ (riboflavin)	Vitamin B complex, vitamin C.
Vitamin B ₃ (niacin)	Vitamin B complex, vitamin C.

VITAMINS	SUPPLEMENTS NEEDED FOR ASSIMILATION
Vitamin B ₅ (pantothenic acid)	Vitamin B complex, vitamins A, C, and E.
Vitamin B ₆ (pyridoxine)	Potassium, vitamin B complex, vitamin C.
Biotin	Folic acid, vitamin B complex, pantothenic acid (vitamin B ₅), vitamin B ₁₂ , vitamin C.
Choline	Vitamin B complex, vitamin B ₁₂ , folic acid, inositol.
Inositol	Vitamin B complex, vitamin C.
Para-aminobenzoic acid (PABA)	Vitamin B complex, folic acid, vitamin C.
Vitamin C	Bioflavonoids, calcium, magnesium.
Vitamin D	Calcium, choline, essential fatty acids, phosphorus, vitamins A and C.
Vitamin E	Essential fatty acids, manganese, selenium, vitamin A, vitamin B ₁ (thiamine), inositol, vitamin C.
Essential fatty acids	Vitamins A, C, D, and E.
MINERALS	SUPPLEMENTS NEEDED FOR ASSIMILATION
Calcium	Boron, essential fatty acids, lysine, magnesium, manganese, phosphorus, vitamins A, C, D, and E.
Copper	Cobalt, folic acid, iron, zinc.
Iodine	Iron, manganese, phosphorus.
Magnesium	Calcium, phosphorus, potassium, vitamin B ₆ (pyridoxine), vitamins C and D.
Manganese	Calcium, iron, vitamin B complex, vitamin E.
Phosphorus	Calcium, iron, manganese, sodium, vitamin B ₆ (pyridoxine).
Silicon	Iron, phosphorus.
Sodium	Calcium, potassium, sulfur, vitamin D.
Sulfur	Potassium, vitamin B ₁ (thiamine), pantothenic acid (vitamin B ₅), biotin.
Zinc	Calcium, copper, phosphorus, vitamin B ₆ (pyridoxine).

There are certain cautions that you should take into account when taking supplements. Antibiotics interfere with the natural balance of normal intestinal flora needed to produce vitamin K, which is necessary for normal blood clotting and maintaining the integrity of the bone. Too much coffee and/or caffeine-containing soft drinks can interfere with calcium metabolism. On the plus side, coffee has been shown to prolong life, possibly by reducing the chances of developing heart disease or diabetes.

NUTRIENT	OPTIMUM DAILY INTAKE*	DAILY VALUE (DV)	TOLERABLE UPPER LEVEL OF INTAKE (UL) PER DAY
Iodine	150–225 mcg	150 mcg	1,100 mcg
Iron**	18–30 mg	18 mg	45 mg
Magnesium	420 mg	420 mg	350 mg
Manganese	3–10 mg	2.3 mg	11 mg
Molybdenum	45–100 mcg	45 mcg	2,000 mcg
Phosphorus		1,250 mg	4,000 mg
Potassium	At least 1,250 mg	4,700 mg	Not determined
Selenium	100–200 mcg	55 mcg	400 mcg
Sodium		2,300 mg	2,300 mg
Zinc	30–50 mg	11 mg	40 mg

Minerals without DVs

Boron (picolinate or citrate)	3–6 mg		20 mg
Vanadium (vanadyl sulfate)	200 mcg to 1 mg		1.8 mg

Amino acids (essential)

	mg per pound body weight per day (based on 154-pound person)	No upper limits established
Histidine	1,540 mg	
Isoleucine	3,080 mg	
Leucine	6,006 mg	
Lysine	4,620 mg	
Methionine + cysteine	2,310 mg	
Phenylalanine + tyrosine	3,850 mg	
Threonine	2,310 mg	
Tryptophan	616 mg	
Valine	4,004 mg	
Total essential amino acids	~28 grams	

Amino acids (nonessential)***

Acetyl-L-carnitine	100–500 mg
Acetyl-L-cysteine	100–500 mg
L-carnitine	500 mg
Taurine	100–500 mg

*Be careful not to confuse milligrams (mg) with micrograms (mcg). A microgram is 1/1,000 of a milligram, or 1/1,000,000 of a gram.

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**You should take iron supplements only if you have been diagnosed with a deficiency of this mineral. Always take iron supplements separately, rather than in a multivitamin and mineral formula.

***See AMINO ACIDS for more information. You should not take individual amino acids on a regular basis unless you are using them for the treatment of a specific disorder. Requirements are for a minimum and obtained from the WHO Technical Report Series 935, 2002.

OPTIONAL SUPPLEMENTS****

OPTIMUM DAILY INTAKES

Chondroitin sulfate	As directed on label.
Coenzyme Q ₁₀	30–100 mg
Cryptoxanthin	110 mcg
Essential fatty acids (EFAs) (primrose oil, flaxseed oil, salmon oil, and fish oil are good sources)	As directed on label.
Flavonoids (citrus fruits and berries)	As directed on label.
Garlic	As directed on label.
Ginkgo biloba (herb)	As directed on label.
Glucosamine sulfate	As directed on label.
Lecithin	200–500 mg
Lutein/lycopene	As directed on label.
Pectin	50–100 mg
Phosphatidylcholine	As directed on label.
Phosphatidylserine	As directed on label.
Pycnogenol or grape seed extract (OPCs)	As directed on label.
Quercetin	70–140 mg
RNA-DNA	100 mg
Silicon	As directed on label.
Soy isoflavones (genistein)	As directed on label.
Superoxide dismutase (SOD)	As directed on label.
Zeaxanthin	90 mcg

****See NATURAL FOOD SUPPLEMENTS for more information.

Other supplements that you may wish to take for increased energy include the following:

- Bee pollen.
- Coenzyme A.
- Coenzyme 1 (nicotinamide adenine dinucleotide with high-energy hydrogen, or NADH; sold under the brand name Enada).
- Free-form amino acid.
- Kyo-Green from Wakunaga of America.
- N, N-Dimethylglycine (DMG).
- Octacosanol.
- Siberian ginseng.
- Spirulina.
- Wheat germ.

In addition, there are many good formulas on the market specifically formulated to help meet the nutritional needs of infants and children.

rients you are taking to make sure all the pieces of the puzzle fit together.

If you are not used to taking supplements, especially in larger-than-normal doses, your body may need time to adjust. Always take a multivitamin/multimineral supplement with food—if possible, with the biggest meal of the day—to avoid stomach upset and foster better absorption of the nutrients. Otherwise, if the tablet can be split in two, take half in the morning and half at the evening meal.

Daily dosages are suggested; however, before using any supplements, you should consult with your health care provider. The dosages given here are for adults and children weighing 100 pounds and over. Appropriate dosages for children vary according to age and weight. A child weighing between 70 and 100 pounds should be given three-quarters the adult dose; a child weighing less than 70 pounds (and over the age of six years) should be given one-half the adult dose. A child under the age of six years should be given nutritional formulas designed specifically for young children. Follow the dosage directions on the product label. Many products have not been directly tested for use by children, so be sure to check with the child's health care provider before giving any supplement to a child. Besides vitamins and minerals, other nutrients that have been tested in children include *Andrographis paniculata*, cranberry, echinacea, evening primrose oil, garlic, ivy leaf, and valerian.

I recommend using only quality supplements from a reputable source. Lower-priced supplements can mean lower quality, with higher levels of fillers and other undesirable ingredients. Give your body the best—it deserves it. Of course, it is better to take the supplements than not, so if you can't afford the higher-quality vitamins, then use the lower-cost ones. If you cannot locate one or more of the supplements recommended in this book, you can call, write, or email one of the sources listed in the Appendix.

For your reference, both milligrams (mg) and micrograms (mcg) refer to specific weights. The old system of using an international unit (IU) was the amount of a vitamin, mineral, or other substance that elicited a certain biological activity. It is easy to convert IU to the newer system using these guidelines:

- Vitamin A: 1 IU = 0.3 mcg vitamin A
- Vitamin D: 1 IU = 0.025 mcg
- Vitamin E: 1 IU = 0.67 mg d-alpha-tocopherol (based on the synthetic form)

Nutrients with a corresponding DV do not have a constraint as to how the nutrient is delivered. For example, calcium that comes from milk or a supplement of carbonate or citrate are considered to be the same, despite each having different absorption rates. Studies have found that people who regularly take supplements typically have a better quality of life, a lower risk of heart attack and diabetes, and lower blood pressure compared to those who do not take supplements.

NUTRIENT	OPTIMUM DAILY INTAKE*	DAILY VALUE (DV)	TOLERABLE UPPER LEVEL OF INTAKE (UL) PER DAY FOR ADULTS
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Vitamins with DVs

Vitamin A (retinol and carotenoids)	1,500–3,000 mcg (formerly 5,000–10,000 IU)	900 mcg (formerly 3,000 IU)	3,000 mcg
Thiamine (B ₁)	50–100 mg	1.2 mg	Not determined
Riboflavin (B ₂)	15–50 mg	1.3 mg	Not determined
Niacin (B ₃)	16–35 mg	16 mg	35 mg
Pantothenic acid	50–100 mg	5 mg	Not determined
Vitamin B ₆	50–100 mg	1.7 mg	100 mg
Vitamin B ₁₂	200–400 mcg	2.4 mcg	Not determined
Biotin		30 mcg	
Choline	At least 550 mg	550 mg	3,500 mg
Folic acid	400–800 mcg	400 mcg (as dietary folate equivalents)	1,000 mcg
Vitamin C	1,000–2,000 mg	90 mg	2,000 mg
Vitamin D	At least 20 mcg (formerly 400 IU)	20 mcg (formerly 800 IU)	100 mcg
Vitamin E	90 mg (formerly 200 IU)	15 mg (formerly 33 IU)	1,000 mg
Vitamin K		120 mcg	

Vitamins without DVs

No DVs established

Inositol	50–200 mg		
Para-aminobenzoic acid (PABA)	10–50 mg		
Bioflavonoids (mixed)	200–500 mg		
Hesperidin	50–100 mg		
Rutin	25 mg		

Minerals with DVs

Calcium	1,800–2,000 mg	1,300 mg	2,000 mg
Chloride		2,300 mg	3,600 mg
Chromium	150–400 mcg	35 mcg	Not determined
Copper	2–3 mg	0.9 mg	10 mg (10,000 mcg)

dium, and potassium. RDIs are a set of dietary references based on the Recommended Dietary Allowances for essential vitamins and minerals and, in selected groups, protein. The term *RDI* replaces *U.S. RDA*.

Starting in 1998 the Food and Nutrition Board of the Institute of Medicine began publishing new information about nutrient requirements. These were referred to as the Dietary Reference Intakes (DRIs), and later adopted by the Food and Drug Administration to serve as the basis of the DVs on the new food labels. The nutrient DVs on food labels are appropriate for anyone aged four years and older.

The amounts of these nutrients defined by the DRI give us about twice the amount needed to ward off vitamin deficiency diseases such as beriberi, rickets, scurvy, and night blindness. What they do not account for are the amounts needed to maintain maximum health, rather than borderline health. Moreover, they are not good at providing an individual's need, but rather population norms.

Scientific studies have shown that taking dosages of vitamins above the DRIs helps our body work better. The DRIs therefore are not very useful for determining what our intake of different vitamins should be. We prefer to speak in terms of *optimum daily intakes* (ODIs)—the amounts of nutrients needed for vibrant good health. This entails consuming larger amounts of vitamins than the DRIs. The nutrient doses recommended on pages 11–12 are ODIs. By providing our bodies with an optimum daily amount of necessary vitamins, we can enhance our health. The dosages outlined in this book will enable you to design a vitamin program that is custom-tailored for the individual. Many nutrients with a DRI also have a corresponding Tolerable Upper Level of Intake (UL), which is usually higher than the DRI and the DV but that has been found to be safe (to learn the ULs for all vitamins and minerals, go to <http://fnic.nal.usda.gov>). The one exception is magnesium; its UL is lower than the recommendation. Consult your health care provider about an appropriate amount to take. Otherwise, do not take more than the UL for any nutrient (unless your health care provider recommends that you do) because it is not safe to do so based on what we know today. Some nutrients do not have corresponding ULs. This means only that no upper toxic limit has been identified and does not mean that large amounts are safe.

FDA'S GOOD MANUFACTURING PRACTICES

Ideally, all of us would get all the nutrients we need for optimal health from fresh, healthful foods. In reality, however, this is often difficult, if not impossible. In our chemically polluted and stress-filled world, our nutritional requirements have been increasing, but the number of calories we require has been *decreasing*, as our general level of physical activity has declined. This means we are faced with needing somehow to get more nutrients from less food. At the same time, many of our foods are depleted of certain nutrients. Modern farming practices have result-

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ed in soils that are lacking in selenium and other nutrients. The main problem is that people just aren't eating nutrient-rich foods according to the Dietary Guidelines for Americans 2015–2020.

Harvesting and shipping practices are dictated not by nutritional considerations but by marketing demands. Add to this extensive processing, improper storage, and other factors, and it is little wonder that many of the foods that reach our tables cannot meet our nutritional needs. Getting even the DRI of vitamins from today's diet has become quite hard to do. This means that for optimum health, it is necessary to take nutrients in supplement form. Dr. Bruce Ames, a well-known nutritional scientist, argues that low dietary intakes of vitamins and minerals are widespread in the United States and that this may accelerate chronic diseases of aging like cancer.

Given the nature of the food supply, everyone would benefit from taking dietary supplements. And supplements have become much safer. Since July 2008, all companies that manufacture dietary supplements must follow Good Manufacturing Practices (GMPs). The FDA has established guidelines for manufacturing procedures so that you actually get the nutrients that are advertised on the label. Also, the new requirements dictate that the products must be clean and free of harmful bacteria and other toxins. The FDA now requires manufacturers to store all the ingredients used in a product after the product has been sold. Each product must have a name and phone number to call if a user becomes ill. The batch number of the product then can be matched to the stored ingredients to help figure out why someone has had an adverse reaction. Some companies have gone beyond GMPs and enlisted the services of NSF, an independent third-party testing organization that tests dietary supplements. Dietary supplements that engage NSF undergo a higher level of scrutiny. Companies that pass the stricter assessment can put an NSF-certified sticker on their products.

Nutrients and Dosages for Maintaining Good Health

The table on the following page—which includes not just vitamin and mineral supplements, but other supplements as well—should be used as a guideline. Although the amounts listed as ODIs are safe (they will not cause toxicity), they should be varied according to a person's size and body weight. People who are active and exercise; those who are under great stress, on restricted diets, or mentally or physically ill; women who take oral contraceptives; those on medication; those who are recovering from surgery; and smokers and those who consume alcoholic beverages—all may need larger-than-normal amounts of certain nutrients.

In addition to a proper diet, exercise and a positive attitude are two important elements that are needed to prevent sickness and disease. If your lifestyle includes each of these, you will feel good and have more energy—something we all deserve. Nature has the answers we need to maintain our health, but you need to know what nu-

NUTRITION

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One other element, *trans-fatty acids*, was used in many food products. It was later found to increase the risk of heart disease. Also called *trans fats*, these substances occur when polyunsaturated oils are altered through hydrogenation, a process used to harden liquid vegetable oils into solid foods like margarine and shortening. As of June 2018, the FDA has banned the use of trans fats. Today you won't find many products that contain trans fats.

It is clear that if your goal is to lower blood cholesterol, polyunsaturated and monounsaturated fats are more desirable than saturated fats. Just as important, your total calories from fat should range between 25 to 35 percent of daily calories.

The Micronutrients: Vitamins and Minerals

Like water, carbohydrates, protein, and fats, and the enzymes required to digest them, vitamins and minerals are essential to life. They are therefore considered nutrients and are often referred to as *micronutrients* simply because they are needed in relatively small amounts compared with the four basic nutrients.

Recommended Dietary Allowances (RDAs) were instituted in 1941 by the National Academy of Sciences' U.S. Food and Nutrition Board as a standard for the daily amounts of vitamins and minerals needed by a healthy person. These RDAs were the basis for the U.S. Recommended Daily Allowances (U.S. RDAs) adopted by the Food and Drug Administration (FDA). The U.S. RDA used to be the term that was used on food labels. However, the provisions of the Nutrition Labeling and Education Act and the Dietary Supplement Act of 1992 required a change in food product labeling to use a new reference term, Daily Value (DV), which began to appear on FDA-regulated product labels in 1994. Today you can look at any food or dietary supplement label and see the percent DV of all essential nutrients contained in the product. DVs are made up of two sets of references: Daily Reference Values (DRVs) and Reference Daily Intakes (RDIs).

DRVs are a set of dietary references that apply to fat, saturated fat, cholesterol, carbohydrate, protein, fiber, so-

Minerals

INTRODUCTION

Every living cell on this planet depends on minerals for proper function and structure. Minerals are needed for the proper composition of body fluids, the formation of blood and bone, the maintenance of healthy nerve function, and the regulation of muscle tone, including that of the muscles of the cardiovascular system. Like vitamins, minerals function as coenzymes, enabling the body to perform its functions, including energy production, growth, and healing. Because all enzyme activities involve minerals, minerals are essential for the proper utilization of vitamins and other nutrients.

The human body, as with all of nature, must maintain its proper chemical balance. This balance depends on the levels of different minerals in the body and especially the ratios of certain mineral levels to one another. The level of each mineral in the body has an effect on every other one, so if one is out of balance, all mineral levels are affected. If not corrected, this can start a chain reaction of imbalances that leads to illness.

Minerals are naturally occurring elements found in the earth. Rock formations are made up of mineral salts. Rock and stone are gradually broken down into tiny fragments by erosion, a process that can take literally millions of years.

The resulting dust and sand accumulate, forming the basis of soil. The soil is teeming with microbes that utilize these tiny crystals of mineral salts, which are then passed from the soil to plants. Herbivorous animals eat the plants. We obtain these minerals by consuming plants or herbivorous animals.

Nutritionally, minerals belong to two groups: bulk minerals (also called macrominerals) and trace minerals (microminerals).

Bulk minerals include calcium, magnesium, sodium, potassium, and phosphorus. These are needed in larger amounts than trace minerals. Although only minute quantities of trace minerals are needed, they are nevertheless important for good health. Trace minerals include boron, chromium, copper, germanium, iodine, iron, manganese, molybdenum, selenium, silicon, sulfur, vanadium, and zinc.

Because minerals are stored primarily in the body's bone and muscle tissue, it is possible to develop mineral toxicity if extremely large quantities are consumed. Such

situations are rare, however, because toxic levels of minerals generally accumulate only if massive amounts are ingested for a prolonged period of time.

WHAT'S ON THE SHELVES

As with vitamins, it can be difficult, if not impossible, to obtain the amounts of minerals needed for optimum health through diet alone. Mineral supplements can help you to make sure you are getting all the minerals your body requires.

Minerals are often found in multivitamin formulas. Minerals also are sold as single supplements. These are available in tablet, capsule, powder, and liquid forms. Some are available in chelated form, which means that the minerals are bonded to protein molecules that transport them to the bloodstream and enhance their absorption. When mineral supplements are taken with a meal, they are usually automatically chelated in the stomach during digestion. There is some controversy over which mineral supplements are best, but we prefer the chelated preparations. Our experience with the various chelated formulas available has shown that, in general, arginate forms of minerals make the most effective supplements.

Once a mineral is absorbed, it must be carried by the blood to the cells and then transported across the cell membranes in a form that can be utilized by the cells. After minerals enter the body, they compete with one another for absorption. For example, too much zinc can deplete the body of copper; excessive calcium intake can affect magnesium absorption (and vice versa). Consequently, supplemental minerals should always be taken in balanced amounts. Otherwise, they will not be effective and may even be harmful. The absorption of minerals can also be affected by the use of fiber supplements. Fiber decreases the body's absorption of minerals. Therefore, supplemental fiber and minerals should be taken at different times.

THE ABCS OF MINERALS

Boron

Boron is needed in trace amounts for healthy bones and muscle growth because it assists in the production of natural steroid compounds within the body. It is also necessary for the metabolism of calcium, phosphorus, and magnesium.